



Final Preliminary Assessment/Site Inspection Report

**Additional and Uncharacterized Sites Operable Unit
Crab Orchard National Wildlife Refuge NPL Site
Marion, Illinois (Williamson County)**

June 2003

This Final PA/SI Report is identical to the
"Draft-Final" Report issued in September 2001.

VOLUME IV

Section 10

18124-1/1-D



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ACRONYM LIST
Crab Orchard AUS OU PA/SI Report

ACRONYM	DEFINITION
3S _b	Mean plus three standard deviations
A.N.	Ammonium Nitrate
ARAR	Applicable, Relevant and Appropriate Requirements
AOC	Area of Concern
AST	Aboveground Storage Tank
ASTER	Assessment Tools for the Management of Risk (USEPA database)
AUS OU	Additional Uncharacterized Sites Operable Unit
BGS	Below Ground Surface
BNA	Base-Neutral Acids
BOD	Biological Oxygen Demand
BOR	U.S. Bureau of Reclamation
BRA	Baseline Risk Assessment
BTAG	Biological Technical Assistance Group
BTOC	Below Top of Casing
BWT	Below Water Table
CCME	Canadian Council of Ministers of the Environment
CERCLA	Comprehensive Environmental Response Compensation and Liability Act of 1980 (a.k.a. Superfund)
CIA	Central Intelligence Agency
CIPS	Central Illinois Public Service
CLP	Contract Laboratory Program
CM/SEC	Centimeters per Second
COC	Chain-of-Custody
COC	Chemical of Concern
COC	Crab Orchard Cemetery
COI	Chemical of Interest
COL	Crab Orchard Lake
CONWR	Crab Orchard National Wildlife Refuge
COP	Crab Orchard Pond
COPC	Chemical of Potential Concern
COPEC	Chemical of Potential Ecological Concern
CSC	Commercial Solvents Corporation
CSEQGs	Canadian Sediment Quality Guidelines
CSOQGs	Canadian Soil Quality Guidelines
CTI	Central Technologies Incorporated
CVOC	Chlorinated Volatile Organic Compounds
CWQG	Canadian Water Quality Guidelines
DAF	Dilution Attenuation Factor
DEHP	bis(2-ethylhexyl)phthalate
DERP	Defense Environmental Restoration Program
DGOLs	New Dutchlist Groundwater Optimum Levels
DNT	Dinitrotoluene
DOD	Department of Defense
DOI	U.S. Department of the Interior

ACRONYM LIST
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ACRONYM	DEFINITION
DQCR	Daily Quality Control Reports
DQO	Data Quality Objective
DRO	Diesel Range Organics
DSOLs	New Dutchlist Soil Optimum Levels
DTW	Depth to water
DU	Depleted Uranium
EMMA OU	Explosives and Munitions Manufacturing Area Operable Unit
EPA	U.S. Environmental Protection Agency
EqP	Equilibrium Partitioning
ERL	Effects-Range Low
ERM	Effects-Range Medium
ESV	Ecological Screening Value
FDAP	Field Director of Ammunition Plants
FFA	Federal Facility Agreement
FID	Flame Ionization Detector
FOIA	Freedom of Information Act
FNH	Flashless Non-hydroscopic Powder
FS	Feasibility Study
FSP	Field Sampling Plan
FT	feet or foot
FWS	U.S. Fish and Wildlife Service
GPS	Global Positioning System
GRO	Gasoline Range Organics
GSA	General Services Administration
GW	Ground Water
HBX	High Blast Explosives
HE	High Explosives
HEDP	High Explosive Detonation Product
HEI	High Explosives Igniter
HMX	Her Majesty's Explosive (Cyclotetramethylenetetranitramine)
HQ	Hazard Quotient
HSA	Hollow Stem Auger
HSP	Health and Safety Plan
IAC	Illinois Administrative Code
IDW	Investigation Derived Waste
IEPA	Illinois Environmental Protection Agency
IPCB	Illinois Pollution Control Board
IOP	Illinois Ordnance Plant
K _{ow}	Octanol-to-Water Partitioning Coefficient
LAW	Light Antitank Weapon
LOEC	Lowest Observed Effects Concentration
MAOU	Metals Area Operable Unit
MATC	Maximum Acceptable Toxicant Concentration

ACRONYM LIST
Crab Orchard AUS OU PA/SI Report

ACRONYM	DEFINITION
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MG/KG	milligrams per kilogram
MG/L	milligrams per liter
MHSPE	Ministry of Housing, Spatial Planning, and the Environment
MISCA OU	Miscellaneous Areas Operable Unit
MM	millimeter
MOCA	4,4' - Methylenebis (2-chloroaniline)
MSDS	Material Safety Data Sheets
MSL	Mean Sea Level
MW	Monitoring Well
NA	Not analyzed
NA	Not applicable
NAPL	Non-aqueous Phase Liquid
NEC	No Effect Concentration
NCP	National Contingency Plan
ND	Not detected
NG	Nitroglycerin
NG/KG	Nanograms per kilogram
NOAA	National Oceanic and Atmospheric Administration
NaOH	Caustic Soda
NOEC	No-observed-effect concentration
NPL	National Priorities List
OD	Outside Diameter
OE	Ordnance and Explosives
OEW	Ordnance and Explosive Waste
OFDAP	Ordnance Field Director of Ammunition Plants
OU	Operable Unit
PA	Preliminary Assessment
PAH	Polynuclear Aromatic Hydrocarbons
PA/SI	Preliminary Assessment/Site Investigation
PBX	Plastic Bonded Explosives
PCB	Poly-chlorinated Biphenyl
PCB OU	PCB Operable Unit
PCE	Tetrachloroethylene
PEC	Probable Effect Concentration
PEL	Probable Effect Level
PETN	Pentaerythritol Tetranitrate
PID	Photo Ionization Detector
PLC	Preliminary Levels of Concern
PM	Project Manager
PPB	Parts Per Billion
PPE	Personnel Protection Equipment

ACRONYM LIST
Crab Orchard AUS OU PA/SI Report

ACRONYM	DEFINITION
PPM	Parts Per Million
PRG	Preliminary Remediation Goals
PRP	Potentially Responsible Party
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QCSR	Quality Control Summary Report
R&D	Research & Development
RAGS	Risk Assessment Guidance for Superfund (USEPA document)
RCRA	Resource Conservation and Recovery Act
RDX	Royal Demolition Explosive (Cyclonite)
RI	Remedial Investigation
RI/FS	Remedial Investigation / Feasibility Study
RL	Reporting Limit
ROD	Record of Decision
RR	Railroad
RRTC	Railroad Tank Car
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act (1986)
SI	Site Investigation
SIU	Southern Illinois University
SMCL	Secondary Maximum Contaminant Level
SMDP	Scientific Management Decision Point
SOP	Standard Operating Procedure
SPO	Solid Propellant Operations
SSLs	Soil Screening Levels (USEPA)
SVOC	Semi-volatile Organic Compound
SWDC	Sherwin Williams Defense Corporation
TACO	Tiered Approach to Corrective Action Objectives
TAL	Target Analyte List
TBD	To Be Determined
TCDD	Tetrachlorodibenzo-p-Dioxin
TCE	Trichloroethylene
TCL	Target Compound List
TDS	Total Dissolved Solids
TEC	Threshold Effect Concentration
TEL	Threshold Effect Level
TEQ	Toxicity Equivalent for Dioxins/Furans
TNT	Trinitrotoluene
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TRPH	Total Recoverable Petroleum Hydrocarbons
TRV	Toxicity Reference Value

ACRONYM LIST
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ACRONYM	DEFINITION
TSS	Total Suspended Solids
UET	Upper Effect Threshold
UG/KG	micrograms per kilogram
UG/L	micrograms per liter
UMC	Universal Match Corporation
USACE	U.S. Army Corp of Engineers
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
ECOTOX	Ecological Toxicity Database
USFWS	United States Fish & Wildlife Service
USGS	United States Geological Survey
UST	Underground Storage Tank
UXO	Unexploded Ordnance
VJ Day	Victory over Japan day (August 15, 1945)
VOCs	Volatile Organic Compounds
WAA	War Assets Administration
WSA	West Shop Area
WWII	World War II
WWTP	Wastewater Treatment Plant

Area 6, shown in Figure 10-1, is the former Illinois Ordnance Plant (IOP) Ammonium Nitrate High Explosive and Smokeless Powder Storage Area. It is located south of Old Highway 13, on the eastern portion of the Refuge, about 0.7 miles south of the intersection of Channesstown Road and Old Highway 13. Channesstown Road runs north and south through the center of Area 6.

AUS Original Site Designations

Area 6 was not included in the original Additional and Uncharacterized Sites Operable Unit (AUS OU) list developed in 1997-1999 by the United States Fish and Wildlife Service (USFWS), except for the northern and southern railroad loading docks (AUS-0020). However, since Area 6 was used to store numerous explosives and other compounds, all of Area 6 was included in the current AUS OU Site Investigation (SI), as Site AUS-0A06. The original site number AUS-0020 was eliminated.

10.1 HISTORIC SEARCH INFORMATION

10.1.1 Site Description

Area 6 consists of 79 explosive storage igloos in 7 rows, each with a truck loading dock.¹ The original IOP drawing, used as the base map for Figures 10-2 and 10-3, shows the names and locations of 84 igloos, but the drawing indicates that 5 of the igloos were not built. All buildings start with the prefix "HE" (high explosives). There is also a northern and southern railroad loading dock on either end of Area 6.² The former railroad passed along the center row of igloos (HE-4-1 through HE-4-12), each of which had a truck loading dock and a railroad loading dock.³ The railways have been dismantled and the north and south loading docks have been abandoned.

Area 6 support activities, the operator/lessees and the buildings housing them are listed in Table 10-1. Lease information was obtained from the records noted in Section 10.1.2, below. It should be noted, however, that there are gaps in the historic lease information. Current lease information was obtained from the USFWS Refuge management.

10.1.2 Operational History and Waste Characteristics

Area 6 has been used for storage since 1942, mostly for explosives-related items. As shown in Table 10-1, other items have also been stored in these igloos.

During the IOP era from 1942 through 1945, all the igloos in this area were used for storage of high explosives by the Sherwin Williams Defense Corporation, under contract to the War Department (SWDC/War Department). Uses by post-World War II industrial tenants are summarized below. Lease information is not complete, and often there is little or no information

¹ U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 4 (Plan no. 6544-101.10).

² U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 4 (Plan no. 6544-101.10).

³ U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 4 (Plan no. 6544-101.10).

about a lessee's activities in the igloos. For each building, available lease information is tabulated and other information relevant to this PA/SI is summarized following the table.

Olin started using the igloos in Area 6 for storage in 1970. Its ordnance manufacturing division was spun off to Primex Technologies, Inc. (Primex) at the end of 1996. In January 2001, General Dynamics Corporation acquired Primex.^{4,5} Primex became a wholly owned subsidiary of General Dynamics and changed its name to General Dynamics Ordnance and Tactical Systems, Inc. (GDO&TS).^{6,7} GDO&TS and Ensign Bickford Industries, Inc. are the current tenants in most of the igloos in Area 6.⁸

Igloo HE-1-1

Lessee	Dates	Igloo Use
Winn-Star, Inc., a.k.a. Winco Company, (pyrotechnic component development and production company) ^{9,10,11,12,13,14,15,16}	1971 to present	Storage of M-6 propellant, and other explosive components such as zirconium metal powder and barium chromate (up to as much as 5,000 pounds (lbs))

⁴ General Dynamics Ordnance and Tactical Systems, Letter to Crab Orchard National Wildlife Refuge regarding Building and Igloo Lease Contract No. 14-16-0003-96-579, changing Primex's name to General Dynamics Ordnance and Tactical Systems, Inc., dated January 29, 2001.

⁵ Amendment No. 13 to Building and Igloo Lease Contract No. 14-16-0003-96-579, Primex Technologies, Inc., effective January 29, 2001; and, Crab Orchard National Wildlife Refuge, Letter to General Dynamics Ordnance and Tactical Systems, Inc. enclosing Amendment No. 13 regarding the Primex name change, dated March 13, 2001.

⁶ General Dynamics Ordnance and Tactical Systems, Letter to Crab Orchard National Wildlife Refuge regarding Building and Igloo Lease Contract No. 14-16-0003-96-579, changing Primex's name to General Dynamics Ordnance and Tactical Systems, Inc., dated January 29, 2001.

⁷ Amendment No. 13 to Building and Igloo Lease Contract No. 14-16-0003-96-579, Primex Technologies, Inc., effective January 29, 2001; and, Crab Orchard National Wildlife Refuge, Letter to General Dynamics Ordnance and Tactical Systems, Inc. enclosing Amendment No. 13 regarding the Primex name change, dated March 13, 2001.

⁸ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁹ Thomas J. Throgmorton, personal interview, November 9, 1999.

¹⁰ DOI 008114 – DOI 008115. Winn-Star, Inc., Letter answering DOI request for information at Crab Orchard Wildlife Refuge, dated July 7, 1989, Pages 1-2.

¹¹ DPRA Document No. 00009392. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, 1971, Table No. 1.

¹² DOI 008119 – DOI 008121. Igloo Lease, Contract No. 14-16-0003-81-510, by and between U.S. Fish and Wildlife Service and Winn-Star, Inc. (Winco Company), dated October 1, 1980.

¹³ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

¹⁴ DPRA Document No. 00002977. United States Department of the Interior, Fish and Wildlife Service, Letter to Winco Company advising receipt of Cooperative Agreement for supplying cannon net charges, dated December 21, 1979.

¹⁵ DPRA Document No. 00003029. Cooperative Agreement No. 14-16-0009-85-975, dated October 7, 1985, Pages 1-3.

¹⁶ DOI 008114 – DOI 008115. Winn-Star, Inc., Letter answering DOI request for information at Crab Orchard Wildlife Refuge, dated July 7, 1989, Pages 1-2.

Winn-Star (Winco Company)

Winn-Star/Winco fabricated cannon-net charges for USFWS utilizing government-furnished M-6 propellant, which Winn-Star/Winco stored in HE-1-1.^{17,18,19}

Igloo HE-1-2

Lessee	Dates	Igloo Use
Olin/Primex/GDO&TS ^{20,21,22,23,24,25}	1978 to present	Explosives and explosive component storage. In 1981 (and in 1985) Olin used this igloo, along with Igloos HE-1-6 and HE-7-1, for storage of hazardous waste. No information was found regarding the type of hazardous waste Olin stored in these igloos.

Igloo HE-1-3

Igloo HE-1-3 was labeled on the IOP drawings but it was never built.²⁶

Igloo HE-1-4

Lessee	Dates	Igloo Use
Olin/Primex/GDO&TS ^{27,28,29,30,31}	1978 to present	Explosives and explosive component storage

¹⁷ DPRA Document No. 00002977. United States Department of the Interior, Fish and Wildlife Service, Letter to Winco Company advising receipt of Cooperative Agreement for supplying cannon net charges, dated December 21, 1979.

¹⁸ DPRA Document No. 00003029. Cooperative Agreement No. 14-16-0009-85-975, dated October 7, 1985, Pages 1-3.

¹⁹ DOI 008114 – DOI 008115. Winn-Star, Inc., Letter answering DOI request for information at Crab Orchard Wildlife Refuge, dated July 7, 1989, Pages 1-2.

²⁰ DPRA Document No. 00025432. Special Use Permit, Permit Number SUP-26-78, dated February 16, 1978.

²¹ DOI 001539. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

²² DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

²³ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8, and 10.

²⁴ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

²⁵ PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

²⁶ U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part I, Section 5, Page 4 (Plan no. 6544-101.10).

²⁷ DPRA Document No. 00025432. Special Use Permit, Permit Number SUP-26-78, dated February 16, 1978.

²⁸ DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

²⁹ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

Igloo HE-1-5

Lessee	Dates	Igloo Use
Olin/Primex/GDO&TS ^{32,33,34,35,36}	1978 to 1985, 1995 to present	Explosives and explosive component storage
John Kelley ^{37,38,39}	Three months in 1989	Explosives storage

Igloo HE-1-6

Lessee	Dates	Igloo Use
Olin/Primex/GDO&TS ^{40,41,42,43,44,45}	1978 to present	Explosives and explosive component storage. In 1981 (and in 1985) Olin used this igloo, along with Igloos HE-1-2 and HE-7-1, for storage of hazardous waste.

³⁰ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

³¹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

³² DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

³³ DOI 001550. Amendment No. 3 to Igloo Lease Contract No. 14-16-0003-81-506, Olin Corporation, dated July 1, 1985.

³⁴ DPRA Document No. 00007571. Amendment No. 9 to Igloo Lease Contract No. 14-16-0003-81-506, Olin Corporation, dated February 1, 1995.

³⁵ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

³⁶ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

³⁷ DPRA Document No. 00006574. Igloo Lease, Contract No. 14-16-0003-89-564, by and between U.S. Fish and Wildlife Service and Mr. John Kelley, dated April 1, 1989, Pages 1 and 2.

³⁸ DPRA Document No. 00006548. U.S. Department of the Interior, Letter to John Kelley deleting Igloo HE-6-1-5 from the lease effective July 1, 1989, dated June 20, 1989.

³⁹ CRO 000231. Refuge files, Table of Industrial Tenants, Crab Orchard National Wildlife Refuge, October, 1990.

⁴⁰ DPRA Document No. 00025432. Special Use Permit, Permit Number SUP-26-78, dated February 16, 1978.

⁴¹ DOI 001539. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

⁴² DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

⁴³ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8, and 10.

⁴⁴ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁴⁵ PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

Igloo HE-1-7

Lessee	Dates	Igloo Use
Sam B. DeNeal ^{46,47}	1971 to 1978 (possibly as early as 1968)	Unknown
Olin/Primex/GDO&TS ^{48,49,50,51,52}	1978 to present	Explosives and explosive component storage

Igloo HE-1-8

Lessee	Dates	Igloo Use
Sam B. DeNeal ^{53,54}	1971 to 1978 (possibly as early as 1968)	Unknown
Olin/Primex/GDO&TS ^{55,56,57,58,59,60}	1978 to present	Explosives and explosive component storage. In 1985, Olin was storing HEI pellets in this igloo.

⁴⁶ CRO 001632 – CRO 001638. Special Use Permit numbers SUP-4-72, SUP-03-73, SUP-03-74, SUP-03-75, SUP-02-76, SUP-92-76, and SUP-64-77.

⁴⁷ CRO 000113. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, 1968, Table No. 1 – Industrial Leasing, Revenue, & Employment.

⁴⁸ DPRA Document No. 00025432. Special Use Permit, Permit Number SUP-26-78, dated February 16, 1978.

⁴⁹ DOI 001539. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

⁵⁰ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

⁵¹ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8, and 10.

⁵² Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁵³ CRO 001632 – CRO 001638. Special Use Permit numbers SUP-4-72, SUP-03-73, SUP-03-74, SUP-03-75, SUP-02-76, SUP-92-76, and SUP-64-77.

⁵⁴ CRO 000113. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, 1968, Table No. 1 – Industrial Leasing, Revenue, & Employment.

⁵⁵ DPRA Document No. 00025432. Special Use Permit, Permit Number SUP-26-78, dated February 16, 1978.

⁵⁶ DOI 001539. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

⁵⁷ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

⁵⁸ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8, and 10.

⁵⁹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁶⁰ PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

Igloo HE-1-9

Lessee	Dates	Igloo Use
Olin/Primex/GDO&TS ^{61,62,63,64,65,66}	1978 to present	Explosives and explosive component storage. In 1985, Olin stored "repackaged 'C' Rubber" in this igloo.

Igloo HE-1-10

Lessee	Dates	Igloo Use
S & W Ammunition Company (owned by Smith & Wesson, in turn owned by Bangor Punta Diversified Holdings Corp) ^{67,68,69}	1972 to 1976	Storage of Alcan propellant gunpowder
Atlas Powder Company ^{70,71}	1976 to 1979	Explosives storage
Wildlife Materials, Inc. (makers of radio-tracking and capture equipment for wildlife) ^{72,73,74,75}	1985 to 1987	Storage of up to 2,825 lbs of black powder (2FG, 3FG, and 4FG); 29,726 lbs of M-6 (240-mm Howitzer) propellant powder in solid pellet form; and 141,308 electric squibs
El Dorado Chemical Company ^{76,77}	1988 to 1990	Likely storage of ammonium nitrate fertilizer, sulphate of ammonia, and urea fertilizer as noted in the discussion following this table

⁶¹ DPRA Document No. 00025432. Special Use Permit, Permit Number SUP-26-78, dated February 16, 1978.

⁶² DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

⁶³ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

⁶⁴ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

⁶⁵ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁶⁶ PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

⁶⁷ DOI 007564. Responses and Objections of S & W Ammunition Company to 104(e) Request, Page 5.

⁶⁸ CRO 001565 – CRO 001568. Special Use Permit numbers SUP-34-72, SUP-39-73, SUP-41-74, and SUP-40-75.

⁶⁹ DOI 007561 – DOI 007562. Responses and Objections of S & W Ammunition Company to 104(e) Request, Pages 2-3.

⁷⁰ CRO 001596 – CRO 001598. Special Use Permit numbers SUP-76-76, SUP-40-77, SUP-34-78.

⁷¹ CRO 001596 – CRO 001598. Special Use Permit numbers SUP-76-76, SUP-40-77, SUP-34-78.

⁷² DOI 008067. Wildlife Materials, Inc.'s response to Section 104(e) request, Page 1.

⁷³ DPRA Document No. 00003204. Amendment No. 1 to Igloo Lease Contract No. 14-16-0003-81-509, Wildlife Material, Inc., dated March 1, 1985.

⁷⁴ CRO 000629. Amendment No. 2 to Igloo Lease Contract No. 14-16-0003-81-509, Wildlife Materials, Inc., dated December 1, 1987.

⁷⁵ DOI 008068 - DOI 008069. Wildlife Materials, Inc.'s response to Section 104(e) request, Pages 2-3.

⁷⁶ FWM 000942. Amendment No. 3 to Igloo Lease Contract No. 14-16-0003-83-541, El Dorado Chemical Company, dated December 1, 1983.

⁷⁷ DPRA Document No. 00006658. Amendment No. 4 to Igloo Lease Contract No. 14-16-0003-83-541.

Lessee	Dates	Igloo Use
Olin/Primex/GDO&TS ^{78,79,80,81,82}	1991 to present	Explosives and explosive component storage. In 1985, Olin stored "repackaged 'C' Rubber" in this igloo.

S & W Ammunition Company

The propellant gunpowder was handled in plastic bags and encased in zinc-lined wooden crates that were shut with 24-inch nails.⁸³ Lead or lead compounds may have been constituents of the gunpowder.⁸⁴

El Dorado Chemical Company

El Dorado Chemical Company (EDC) began leasing igloos at the Refuge in 1983⁸⁵ when they bought Monsanto's ammonium nitrate business.⁸⁶ Monsanto was storing ammonium nitrate fertilizer, sulphate of ammonia, and urea fertilizer at the Refuge.⁸⁷ EDC likely stored the same chemicals in HE-1-10.

Igloo HE-1-11

Lessee	Dates	Igloo Use
Explosives, Inc. ^{88,89}	1959 up to possibly 1964 (see discussion following table)	Unknown
Olin/Primex/GDO&TS ^{90,91,92,93,94}	1978 to present	Explosives and explosive component storage. In 1985, Olin stored "repackaged 'C' rubber" in this igloo.

⁷⁸ DPRA Document No. 00007566. Amendment No. 7 to Igloo Lease Contract No. 14-16-0003-81-506, dated December 1, 1991.

⁷⁹ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

⁸⁰ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

⁸¹ Industrial Tenant Roster -- March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁸² PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

⁸³ DOI 007562. Responses and Objections of S & W Ammunition Company to 104(e) Request, Page 3.

⁸⁴ DOI 007563. Responses and Objections of S & W Ammunition Company to 104(e) Request, Page 4.

⁸⁵ DPRA Document No. 00006649. Igloo Lease, Contract No. 14-16-0003-83-541, by and between U.S. Fish and Wildlife Service and E.D.C., Incorporated.

⁸⁶ DOI 007368. Monsanto's response to Section 104(e) request, Page 2.

⁸⁷ DOI 007368. Monsanto's response to Section 104(e) request, Page 2.

⁸⁸ DPRA Document No. 00009369. U.S. Department of the Interior, Bureau of Sport Fisheries & Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, January thru April, 1959, Page 24 and Table No. VIII -- Industrial Leasing, Revenue, & Employees.

⁸⁹ Refuge Narrative Reports from May 1959 through April 1963.

Igloo HE-1-12

Lessee	Dates	Igloo Use
Explosives, Inc. ^{95,96}	1959 up to possibly 1964 (see discussion for HE-1-11)	Unknown
Warren O. Heidbreder ^{97,98}	1970 to 1978 (possibly from as early as 1968)	Explosives storage
Austin Powder Company ⁹⁹	1979 to 1997	Likely hazardous materials (see discussion following this table)
Ensign Bickford Industries, Inc. ¹⁰⁰	Current tenant (no information was found regarding an initial occupancy date)	Unknown

⁹⁰ DPRA Document No. 00025432. Special Use Permit , Permit Number SUP-26-78, dated February 16, 1978.

⁹¹ DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

⁹² DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

⁹³ PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

⁹⁴ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁹⁵ DPRA Document No. 00009369. U.S. Department of the Interior, Bureau of Sport Fisheries & Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, January thru April, 1959, Page 24 and Table No. VIII – Industrial Leasing, Revenue, & Employees.

⁹⁶ Refuge Narrative Reports from May 1959 through April 1963.

⁹⁷ CRO 001639 – CRO 001644. Special Use Permit numbers SUP-104-70, SUP-17-72, SUP-19-73, SUP-19-74, SUP-23-75, and SUP-22-76.

⁹⁸ CRO 001000 and CRO 001002. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, September 1 thru December 31, 1962, Page 32 and Table No. 3 – Industrial Leasing, Revenue, & Employment.

⁹⁹ DPRA Document No. 00003635. United States Department of the Interior, Letter to Austin Powder Company regarding drive-through inspection of Area 6 with a list of maintenance items for various igloos leased by Austin Powder, dated May 2, 1985.

¹⁰⁰ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Austin Powder Company

During its tenure, Austin stored the following hazardous materials at the Refuge: Composition B (dry flake combination of Royal Demolition Explosive (RDX) and trinitrotoluene (TNT)), Detonating Cord (fiber wrapped dry explosive containing pentaerythritol tetranitrate (PETN)), Cast Boosters (paper wrapped solid explosives), and ammonium nitrate/fuel oil (mixture of ammonium nitrate prills and fuel oil in plastic bags).¹⁰¹

Igloo HE-2-1

Lessee	Dates	Igloo Use
Trojan Powder Company (U.S. Powder Division) ¹⁰²	1962 to 1967	Explosives storage
Refuge ¹⁰³	1998	572 metal drums of propellant (likely M-6)

Igloo HE-2-2

Lessee	Dates	Igloo Use
Trojan Powder Company ¹⁰⁴	1962 to 1967	Explosives storage
Primex/GDO&TS ^{105,106}	1999 to present	Explosives storage

Igloo HE-2-3

Lessee	Dates	Igloo Use
Trojan Powder Company ¹⁰⁷	1962 to 1967	Explosives storage
Olin/Primex/GDO&TS ^{108,109,110,111,112,113}	1978 to present	Explosives storage. In 1985, Olin stored 30-mm propellant in this igloo.

¹⁰¹ DOI 000157. Austin Powder's response to Section 104(e) request for information, Page 2.

¹⁰² DPRA Document Nos. 00005537, 00005574, 00005572, 00005571, and 00005568. Special Use Permit numbers 39545, SUP-2-64, SUP-2-65, SUP-1-66, and SUP-3-67.

¹⁰³ DPRA Document No. 00017686. Hard copy of e-mail from Doyle Case to Daniel Doshier regarding Explosion at Crab Orchard Igloo, dated December 17, 1989.

¹⁰⁴ DPRA Document Nos. 00005537, 00005574, 00005572, 00005571, and 00005568. Special Use Permit numbers 39545, SUP-2-64, SUP-2-65, SUP-1-66, and SUP-3-67.

¹⁰⁵ DPRA Document No. 00017723. Amendment No. 6 to Building and Igloo Lease Contract No. 14-16-0003-96-579, Primex Technologies, Inc., dated September 1, 1999.

¹⁰⁶ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

¹⁰⁷ DPRA Document Nos. 00005537, 00005574, 00005572, 00005571, and 00005568. Special Use Permit numbers 39545, SUP-2-64, SUP-2-65, SUP-1-66, and SUP-3-67.

¹⁰⁸ DPRA Document No. 00025432. Special Use Permit, Permit Number SUP-26-78, dated February 16, 1978.

¹⁰⁹ DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

Igloo HE-2-4

Lessee	Dates	Igloo Use
Trojan Powder Company ¹¹⁴	1962 to 1967	Explosives storage
Olin/Primex/GDO&TS ^{115,116,117,118,119,120}	1978 to present	Explosives storage. In 1985, Olin stored Phalanx propellant in this igloo.

Igloo HE-2-5

Lessee	Dates	Igloo Use
Trojan Powder Company ¹²¹	1962 to 1970	Explosives storage
Kilbourn Specialties ¹²²	1970 to 1972	Storage of unspecified materials
World Fireworks Display Co., Inc. (a manufacturer and distributor of fireworks and other pyrotechnic and explosive products) ^{123,124,125,126,127}	1973 to 1987	Storage of 50-lb boxes of black powder (charcoal, sulphur, and potassium nitrate)

¹¹⁰ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

¹¹¹ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

¹¹² Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

¹¹³ PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

¹¹⁴ DPRA Document Nos. 00005537, 00005574, 00005572, 00005571, and 00005568. Special Use Permit numbers 39545, SUP-2-64, SUP-2-65, SUP-1-66, and SUP-3-67.

¹¹⁵ DPRA Document No. 00025432. Special Use Permit, Permit Number SUP-26-78, dated February 16, 1978.

¹¹⁶ DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

¹¹⁷ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

¹¹⁸ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

¹¹⁹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

¹²⁰ PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

¹²¹ DPRA Document Nos. 00005537, 00005574, 00005572, 00005571, 00005568, 00005566, 00005562, 00005565, 00006271, and 00005589. Special Use Permit numbers 39545, SUP-2-64, SUP-2-65, SUP-1-66, SUP-3-67, SUP-1-68, SUP 3-69, SUP-5-70, SUP-83-70, and a letter from Trojan-U.S. Powder to Fish & Wildlife Service canceling their lease in this building, dated October 1, 1970.

¹²² CRO 001650 – CRO 001652. Special Use Permit numbers SUP-107-70, SUP-33-71, and SUP-16-72.

¹²³ DPRA Document No. 00004053. Articles of Incorporation, Form B, Article Four.

¹²⁴ DPRA Document Nos. 00018012, 00018018, 00018027, 00018032, 00018034, and 00018036. Special Use Permit numbers SUP-08-73, SUP-07-75, SUP-06-76, SUP-96-76, SUP-68-77, and SUP-75-78.

¹²⁵ CRO 000631 – CRO 000632. Igloo Lease, Contract No. 14-16-0003-81-508, by and between U.S. Fish and Wildlife Service and World Fireworks Display Company, Inc., dated October 1, 1980, Page 1 and Page 1 of 1A.

SECTION TEN

Area 6 (AUS-0A06)

Lessee	Dates	Igloo Use
John Kelley ^{128,129,130}	1989 to 1991	Explosives storage
Silverado Fireworks ¹³¹	Current tenant (no information was found regarding an initial occupancy date)	Unknown

Igloo HE-2-6

Lessee	Dates	Igloo Use
Trojan Powder Company ¹³²	1962 to 1968	Explosives storage
Olin/Primex/GDO&TS ^{133,134,135,136,137,138}	1978 to present	Explosives and/or explosive component storage. In 1985, Olin stored a product identified only as "MT" in this igloo.

Igloo HE-2-7

Lessee	Dates	Igloo Use
Trojan Powder Company ¹³⁹	1962 to 1968	Explosives storage

¹²⁶ CRO 000642. Amendment No. 4 to Igloo Lease No. 14-16-0003-81-508, World Fireworks Display, Co., Inc., dated October 1, 1987.

¹²⁷ DOI 008132 – DOI 008133. World Fireworks Display Co., Inc.'s response to Section 104(e) request.

¹²⁸ DPRA Document No. 00006574. Igloo Lease, Contract No. 14-16-0003-89-564, by and between U.S. Fish and Wildlife Service and Mr. John Kelley, dated April 1, 1989, Pages 1 and 2.

¹²⁹ DPRA Document No. 00006580. Amendment No. 3 to Igloo Lease Contract No. 14-16-0003-89-564, effective March 1, 1991.

¹³⁰ CRO 000231. Refuge files, Table of Industrial Tenants, Crab Orchard National Wildlife Refuge, October, 1990.

¹³¹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

¹³² DPRA Document Nos. 00005540, 00005574, 00005572, 00005571, 00005568, and 00005566. Special Use Permit numbers 35199, SUP-2-64, SUP-2-65, SUP-1-66, SUP-3-67, and SUP-1-68.

¹³³ DPRA Document No. 00025432. Special Use Permit, Permit Number SUP-26-78, dated February 16, 1978.

¹³⁴ DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

¹³⁵ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

¹³⁶ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

¹³⁷ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

¹³⁸ PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

¹³⁹ DPRA Document Nos. 00005540, 00005574, 00005572, 00005571, 00005568, and 00005566. Special Use Permit numbers 35199, SUP-2-64, SUP-2-65, SUP-1-66, SUP-3-67, and SUP-1-68.

Lessee	Dates	Igloo Use
Austin Powder Company ¹⁴⁰	1979 to 1997	Explosives storage (See discussion under HE-1-12)
Ensign Bickford Industries, Inc. ¹⁴¹	Current tenant (no information was found regarding an initial occupancy date)	Unknown

Igloo HE-2-8

Lessee	Dates	Igloo Use
Trojan Powder Company ¹⁴²	1962 to 1970	Explosives storage
Austin Powder Company ¹⁴³	1979 to 1997	Explosives storage (See discussion under HE-1-12)
Ensign Bickford Industries, Inc. ¹⁴⁴	Current tenant (no information was found regarding an initial occupancy date)	Unknown

Igloo HE-2-9

Lessee	Dates	Igloo Use
Trojan Powder Company ¹⁴⁵	1962 to 1970	Explosives storage
Austin Powder Company ¹⁴⁶	1979 to 1997	Explosives storage (See discussion under HE-1-12)

¹⁴⁰ DOI 000157. Austin Powder's response to Section 104(e) request for information, Page 2.

¹⁴¹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

¹⁴² DPRA Document Nos. 00005540, 00005574, 00005572, 00005571, 00005568, 00005566, 00005562, 00005565, 00006271, and 00005589. Special Use Permit numbers 35199, SUP-2-64, SUP-2-65, SUP-1-66, SUP-3-67, SUP-1-68, SUP 3-69, SUP-5-70, SUP-83-70, and a letter from Trojan-U.S. Powder to Fish & Wildlife Service canceling their lease in this building, dated October 1, 1970.

¹⁴³ DOI 000157. Austin Powder's response to Section 104(e) request for information, Page 2.

¹⁴⁴ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

¹⁴⁵ DPRA Document Nos. 00005540, 00005574, 00005572, 00005571, 00005568, 00005566, 00005562, 005565, 00006271, and 00005589. Special Use Permit numbers 35199, SUP-2-64, SUP-2-65, SUP-1-66, SUP-3-67, SUP-1-68, SUP 3-69, SUP-5-70, SUP-83-70, and a letter from Trojan-U.S. Powder to Fish & Wildlife Service canceling their lease in this building, dated October 1, 1970.

¹⁴⁶ DOI 000157. Austin Powder's response to Section 104(e) request for information, Page 2.

Lessee	Dates	Igloo Use
Ensign Bickford Industries, Inc. ¹⁴⁷	Current tenant (no information was found regarding an initial occupancy date)	Unknown

Igloo HE-2-10

Lessee	Dates	Igloo Use
Trojan Powder Company ¹⁴⁸	1962 to 1970	Explosives storage
Austin Powder Company ¹⁴⁹	1979 to 1997	Explosives storage (See discussion under HE-1-12)
Ensign Bickford Industries, Inc. ¹⁵⁰	Current tenant (no information was found regarding an initial occupancy date)	Unknown

Igloo HE-2-11

Lessee	Dates	Igloo Use
Trojan Powder Company ¹⁵¹	1962 to 1967	Explosives storage
Olin/Primex/GDO&TS ^{152,153,154,155,156,157}	1978 to present	Explosives and/or explosive component storage. In 1985, Olin stored 30-mm propellant in this igloo.

¹⁴⁷ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

¹⁴⁸ DPRA Document Nos. 00005540, 00005574, 00005572, 00005571, 00005568, 00005566, 00005562, 005565, 00006271, and 00005589. Special Use Permit numbers 35199, SUP-2-64, SUP-2-65, SUP-1-66, SUP-3-67, SUP-1-68, SUP 3-69, SUP-5-70, SUP-83-70, and a letter from Trojan-U.S. Powder to Fish & Wildlife Service canceling their lease in this building, dated October 1, 1970.

¹⁴⁹ DOI 000157. Austin Powder's response to Section 104(e) request for information, Page 2.

¹⁵⁰ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

¹⁵¹ DPRA Document Nos. 00005540, 00005574, 00005572, 00005571, and 00005568. Special Use Permit numbers 35199, SUP-2-64, SUP-2-65, SUP-1-66, and SUP-3-67.

¹⁵² DPRA Document No. 00025432. Special Use Permit, Permit Number SUP-26-78, dated February 16, 1978.

¹⁵³ DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

¹⁵⁴ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

¹⁵⁵ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

¹⁵⁶ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Igloo HE-2-12

Lessee	Dates	Igloo Use
Hanley Industries ^{158,159}	1959 to 1966	Storage of black powder and high explosives
Olin ^{160,161,162,163}	1978 to 1986	Explosives and/or explosive component storage. In 1985, Olin stored 30-mm propellant in this igloo.
El Dorado Chemical Company ^{164,165,166}	1988 to 1990 (possibly as early as 1983)	Likely storage of ammonium nitrate fertilizer, sulphate of ammonia, and urea fertilizer (see discussion under HE-1-10)

This igloo flooded during periods of heavy rain.¹⁶⁷

Transfer Platform HE-2-13

SWDC/War Department used this transfer platform from 1942 through 1945. It is possible that post-World War II (WWII) tenants from Area 6, who are listed in Table 10-1 below, also used this loading/unloading platform. It is likely that this platform was used by tenants that occupied the center row of Area 6 (Igloos HE-4-1 through HE-4-12), since both are along the rail line.

¹⁵⁷ PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

¹⁵⁸ CRO 000824. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, January thru April, 1959, Page 24.

¹⁵⁹ Interview with Hanley Industries, as found in TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page 53.

¹⁶⁰ DPRA Document No. 00025432. Special Use Permit, Permit Number SUP-26-78, dated February 16, 1978.

¹⁶¹ DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

¹⁶² DOI 001551. Amendment No. 4 to Igloo Lease Contract No. 14-16-0003-81-506, Olin Corporation, dated December 1, 1986.

¹⁶³ PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

¹⁶⁴ FWM 000942. Amendment No. 3 to Igloo Lease Contract No. 14-16-0003-83-541, El Dorado Chemical Company, dated December 1, 1983.

¹⁶⁵ DPRA Document No. 00006658. Amendment No. 4 to Igloo Lease Contract No. 14-16-0003-83-541.

¹⁶⁶ DPRA Document No. 00006649. Igloo Lease, Contract No. 14-16-0003-83-541, by and between U.S. Fish and Wildlife Service and E.D.C., Incorporated.

¹⁶⁷ DPRA Document No. 00007525. CONWR, Letter to Olin Corporation regarding deleting igloo HE-2-12 and adding a different igloo due to the flooding of HE-2-12 during heavy rains, dated November 28, 1986.

Igloo HE-3-1

Lessee	Dates	Igloo Use
Great Lakes Terminal and Transport Company (Great Lakes) 168,169,170,171,172,173	1959 to 1961 (possibly to 1962)	Agricultural chemical products: aldrin, bidrin, ciodrin, ciovap, dieldrin, endrin, nemagon, phosdrin, planavin, rabon, vapona, allyl alcohol, azordin, compound 4072, halbard, methyl parathion, parathion, telodrin, niran, and verdan.
Marion Civil Defense/Emergency Service & Disaster Agency/Williamson County Emergency Management Agency ^{174,175,176,177}	1962 to present	Storage of beds, medical supplies, and food rations

Marion Civil Defense/Emergency Service & Disaster Agency/Williamson County Emergency Management Agency

Refuge narrative reports indicate Marion Civil Defense began leasing igloo space in the high explosives area in 1962,¹⁷⁸ probably in HE-3-1.¹⁷⁹ In 1980, Emergency Service & Disaster Agency (Emergency Services), as successor to the Marion Civil Defense agency, took over the lease and stored beds, medical supplies, and food rations.^{180,181} In 2000, the agency's lease was

¹⁶⁸ DPRA Document No. 00009369. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, January thru April, 1959, Page 24.

¹⁶⁹ CRO-000897. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, January thru April, 1961, Table IV.

¹⁷⁰ CRO-000950. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, January thru April, 1962, Table of Industrial Tenants.

¹⁷¹ DOI 001069. Great Lakes Terminal & Transport, Crab Orchard National Wildlife Refuge NPL Site, First Set of Information Requests.

¹⁷² DOI 001104 – DOI 001105. Shell Chemical Company, Inventory Report as of October 22, 1968, Document included in Great Lakes' Response to 104(e) request for information.

¹⁷³ DOI 001106 – DOI 001108. Empty Containers Inventory—Ordill Terminal, December 31, 1968, Document included in Great Lakes' Response to 104(e) request for information.

¹⁷⁴ DPRA Document No. 00024805. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, September 1 thru December 31, 1962, Page 32 and Table No. 3 – Industrial Leasing, Revenue & Employment.

¹⁷⁵ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

¹⁷⁶ FWM 000956 – FWM 000957. Igloo Lease, Contract No. 14-16-0003-81-503 by and between U.S. Fish and Wildlife Service and Emergency Service & Disaster Agency, dated October 1, 1980, Page 1 and Page 1 of 1A.

¹⁷⁷ Interview with Mr. Doyle Case of CONWR, as noted in TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page 51.

¹⁷⁸ DPRA Document No. 00024805. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, September 1 thru December 31, 1962, Page 32 and Table No. 3 – Industrial Leasing, Revenue & Employment.

¹⁷⁹ DPRA Document No. 0003675. Fish and Wildlife Service, Letter to Marion Civil Defense regarding maintenance items required for leased igloos in Area 6, dated March 27, 1979.

¹⁸⁰ FWM 000956 – FWM 000957. Igloo Lease, Contract No. 14-16-0003-81-503 by and between U.S. Fish and Wildlife Service and Emergency Service & Disaster Agency, dated October 1, 1980, Page 1 and Page 1 of 1A.

changed to a cooperative agreement. Emergency Services was later renamed Williamson County Emergency Management Agency and, in this name, is the current tenant in HE-3-1.¹⁸²

Igloo HE-3-2

Lessee	Dates	Igloo Use
Great Lakes Terminal and Transport Company ^{183,184}	1959 to 1961	Agricultural chemical products (see discussion under HE-3-1)
Civil Air Patrol (Group 12, Auxiliary United States Air Force) ^{185,186}	1970 to 1978 (possibly as early as 1968)	Storage of surplus equipment
World Fireworks Display Co., Inc. ^{187,188,189,190}	1981 to 1985	Storage of 50-lb boxes of black powder (charcoal, sulphur, and potassium nitrate)
Winn-Star ¹⁹¹	Current (it is unknown when Winn-Star initially occupied this igloo)	Possibly storage of M-6 propellant (see discussion under HE-1-1)

Igloo HE-3-3

Lessee	Dates	Igloo Use
Olin/Primex/GDO&TS ^{192,193,194,195,196}	1970 to present	Explosives and/or explosive component storage; in 1985, Olin stored 30-mm propellant in this igloo

¹⁸¹ Interview with Mr. Doyle Case of CONWR, as noted in TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page 51.

¹⁸² Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

¹⁸³ DPRA Document No. 00009369. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, January thru April, 1959, Page 24.

¹⁸⁴ CRO-000897. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Crab Orchard National Wildlife Refuge, Narrative Report, January thru April, 1961, Table IV. *Assumed that they vacated one of the two igloos in Area 6 (based on square footage removed).*

¹⁸⁵ CRO 001622 – CRO 001631. Special Use Permit numbers SUP-32-70, SUP-111-70, SUP-29-72, SUP-34-73, SUP-34-74, SUP-28-75, SUP-31-76, SUP-10-77, and SUP-74-78.

¹⁸⁶ CRO 001036. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, 1968, Table No. 1 – Industrial Leasing, Revenue, & Employment.

¹⁸⁷ DPRA Document Nos. 00020503. Amendment No. 1 to Igloo Lease Contract No. 14-16-0003-81-508, World Fireworks Display Company, Inc., dated March 1, 1981.

¹⁸⁸ DPRA Document Nos. 00020498. Amendment No. 3 to Igloo Lease Contract No. 14-16-0003-81-508, World Fireworks Display Company, Inc., dated January 1, 1983.

¹⁸⁹ DPRA Document No. 00003632. Letter from the Refuge to World Fireworks Display Company, Inc. regarding required maintenance items for Igloos in Area 6, dated May 2, 1985.

¹⁹⁰ DOI 008132 – DOI 008133. World Fireworks Display Co., Inc.'s response to Section 104(e) request.

¹⁹¹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Igloo HE-3-4

Lessee	Dates	Igloo Use
Olin/Primex/GDO&TS ^{197,198,199,200,201}	1970 to present	Explosives and/or explosive component storage. In 1985, Olin stored "E.A./J.M" propellant in this igloo.

Igloo HE-3-5

Lessee	Dates	Igloo Use
Trojan Powder Company ²⁰²	1967 to 1968	Explosives storage
Olin/Primex/GDO&TS ^{203,204,205,206,207}	1970 to present	Explosives and/or explosive component storage. In 1985, Olin stored 20-mm propellant in this igloo.

¹⁹² CRO 001541, CRO 001543, CRO 001544, CRO 001549, CRO 001551, CRO 001553, CRO 001555, CRO 001557. Special Use Permit numbers SUP-94-70, SUP-35-71, SUP-78-72, SUP-81-73, SUP-85-74, SUP-72-75, SUP-74-76, and SUP-52-77. A Special Use Permit was not found for the year 1979 but it is likely that Olin did occupy this igloo at that time.

¹⁹³ DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

¹⁹⁴ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

¹⁹⁵ PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

¹⁹⁶ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

¹⁹⁷ CRO 001541, CRO 001543, CRO 001544, CRO 001549, CRO 001551, CRO 001553, CRO 001555, CRO 001557. Special Use Permit numbers SUP-94-70, SUP-35-71, SUP-78-72, SUP-81-73, SUP-85-74, SUP-72-75, SUP-74-76, and SUP-52-77. A Special Use Permit was not found for the year 1979 but it is likely that Olin did occupy this igloo at that time.

¹⁹⁸ DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

¹⁹⁹ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

²⁰⁰ PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

²⁰¹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

²⁰² DPRA Document Nos 00005567 and 00005566. Special Use Permit numbers SUP-24-67 and SUP-1-68.

²⁰³ CRO 001540, CRO 001543, CRO 001544, CRO 001549, CRO 001551, CRO 001553, CRO 001555, CRO 001557. Special Use Permit numbers SUP-81-70, SUP-35-71, SUP-78-72, SUP-81-73, SUP-85-74, SUP-72-75, SUP-74-76, and SUP-52-77. A Special Use Permit was not found for the year 1979 but it is likely that Olin did occupy this igloo at that time.

²⁰⁴ DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

²⁰⁵ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

²⁰⁶ PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

Igloo HE-3-6

Lessee	Dates	Igloo Use
Olin/Primex/GDO&TS ^{208,209,210,211,212}	1972 to present	Explosives and/or explosive component storage. In 1985, Olin stored a product identified only as "MT" in this igloo.

Igloo HE-3-7

Lessee	Dates	Igloo Use
Trojan Powder Company ²¹³	1967 to 1970	Explosives storage
Austin Powder Company ^{214,215,216,217}	1979 to 1997	Explosives storage (See discussion under HE-1-12)
Ensign Bickford Industries, Inc. ²¹⁸	Current tenant (no information was found regarding an initial occupancy date)	Unknown

²⁰⁷ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

²⁰⁸ CRO 001545, CRO 001550, CRO 001552, CRO 001554, CRO 001562, CRO 001558, CRO 001559, and CRO 001561. Special Use Permit numbers SUP-12-73, SUP-12-74, SUP-12-75, SUP-14-76, SUP-102-76, SUP-10-78, SUP-04-79, and SUP-03-80.

²⁰⁹ DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

²¹⁰ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

²¹¹ PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

²¹² Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

²¹³ DPRA Document Nos 00005567, 00005566, 00005562, 00005565, 00006271, and 00005589. Special Use Permit numbers SUP-24-67, SUP-1-68, SUP-3-69, SUP-5-70, SUP-83-70, and a letter from Trojan-U.S. Powder to Fish & Wildlife Service canceling their lease in this building, dated October 1, 1970.

²¹⁴ DPRA Document No. 00003704. Fish and Wildlife Service, Letter to Austin Powder Company regarding maintenance items required for leased igloos in Area 6, dated March 28, 1979.

²¹⁵ DOI 000164 – DOI 000165. Igloo Lease Contract No. 14-16-0003-81-500 by and between U.S. Fish and Wildlife Service and Austin Powder Company, dated October 1, 1980, Page 1 and Page 1 of Page 1A.

²¹⁶ CRO 000231. Refuge files, Table of Industrial Tenants, Crab Orchard National Wildlife Refuge, October, 1990.

²¹⁷ DOI 000157. Austin Powder's response to Section 104(e) request for information, Page 2.

²¹⁸ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Igloo HE-3-8

Lessee	Dates	Igloo Use
Olin/Primex/GDO&TS ^{219,220,221,222,223}	1970 to present	Explosives and/or explosive component storage. In 1985, Olin stored 30-mm propellant in this igloo.

Igloo HE-3-9

Lessee	Dates	Igloo Use
Trojan Powder Company ²²⁴	1966 to 1968	Explosives storage
Olin/Primex/GDO&TS ^{225,226,227,228,229}	1970 to present	Explosives and/or explosive component storage. In 1985, Olin stored 20-mm fuses in this igloo.

Igloo HE-3-10

Lessee	Dates	Igloo Use
Trojan Powder Company ²³⁰	1966 to 1973	Explosives storage

²¹⁹ CRO 001540, CRO 001543, CRO 001544, CRO 001549, CRO 001551, CRO 001553, CRO 001555, CRO 001557. Special Use Permit numbers SUP-81-70, SUP-35-71, SUP-78-72, SUP-81-73, SUP-85-74, SUP-72-75, SUP-74-76, and SUP-52-77. A Special Use Permit was not found for the year 1979 but it is likely that Olin did occupy this igloo at that time.

²²⁰ DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

²²¹ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

²²² PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

²²³ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

²²⁴ DPRA Document Nos 00005570, 00005568, and 00005566. Special Use Permit numbers SUP-34-66, SUP-3-67, and SUP-1-68.

²²⁵ CRO 001540, CRO 001543, CRO 001544, CRO 001549, CRO 001551, CRO 001553, CRO 001555, CRO 001557. Special Use Permit numbers SUP-81-70, SUP-35-71, SUP-78-72, SUP-81-73, SUP-85-74, SUP-72-75, SUP-74-76, and SUP-52-77. A Special Use Permit was not found for the year 1979 but it is likely that Olin did occupy this igloo at that time.

²²⁶ DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

²²⁷ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

²²⁸ PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

²²⁹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

²³⁰ DPRA Document Nos. 00005570, 00005568, 00005566, 00005562, 00005565, 00006271, 00005560, and 00005547. Special Use Permit numbers SUP-34-66, SUP-3-67, SUP-1-68, SUP-3-69, SUP-5-70, SUP-83-70, SUP-1-72, and SUP-02-73.

Lessee	Dates	Igloo Use
Hanley Industries ^{231,232,233}	1980 to present	Black powder and high explosives

Igloo HE-3-11

Lessee	Dates	Igloo Use
Trojan Powder Company ²³⁴	1966 to 1973	Explosives storage
Austin Powder Company ^{235,236,237,238}	1979 to 1997	Explosives storage (See discussion under HE-1-12)
Ensign Bickford Industries, Inc. ²³⁹	Current tenant (no information was found regarding an initial occupancy date)	Unknown

Igloo HE-3-12

Lessee	Dates	Igloo Use
Propellex Division ^{240,241,242,243,244}	1958 to present	Likely storage of propellants, explosive devices, and ammonium nitrate-fuel oil containing triethylene glycol dinitrate (see discussion following this table)

²³¹ FWM 000975 – FWM 000976. Igloo Lease, Contract No. 14-16-0003-81-513 by and between U.S. Fish and Wildlife Service and Hanley Industries, Inc., dated May 1, 1980, Page 1 and Page 1 of 1A.

²³² Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

²³³ Interview with Hanley Industries as noted in TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page 53.

²³⁴ DPRA Document Nos. 00005570, 00005568, 00005566, 00005562, 00005565, 00006271, and 00005589. Special Use Permit numbers SUP-34-66, SUP-3-67, SUP-1-68, SUP-3-69, SUP-5-70, SUP-83-70, and a letter from Trojan-U.S. Powder to Fish & Wildlife Service canceling their lease in this building, dated October 1, 1970.

²³⁵ DPRA Document No. 00003704. Fish and Wildlife Service, Letter to Austin Powder Company regarding maintenance items required for leased igloos in Area 6, dated March 28, 1979.

²³⁶ DOI 000164 – DOI 000165. Igloo Lease Contract No. 14-16-0003-81-500 by and between U.S. Fish and Wildlife Service and Austin Powder Company, dated October 1, 1980, Page 1 and Page 1 of Page 1A.

²³⁷ CRO 000231. Refuge files, Table of Industrial Tenants, Crab Orchard National Wildlife Refuge, October, 1990.

²³⁸ DOI 000157. Austin Powder's response to Section 104(e) request for information, Page 2.

²³⁹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

²⁴⁰ DPRA Document Nos. 00005570, 00005568, 00005566, 00005562, 00005565, 00006271, and 00005589. Special Use Permit numbers SUP-34-66, SUP-3-67, SUP-1-68, SUP-3-69, SUP-5-70, SUP-83-70, and a letter from Trojan-U.S. Powder to Fish & Wildlife Service canceling their lease in this building, dated October 1, 1970.

²⁴¹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

²⁴² DOI 007408. Propellex's response to Section 104(e) request for information, Page 1.

²⁴³ DOI 007449. Department of the Secretary of State, Patent and Copyright Office, Canada, Patent Number 692921, dated August 18, 1964.

²⁴⁴ DOI 007409. Propellex's response to Section 104(e) request for information, Page 2.

Propellex Division

Propellex Division, later Propellex Corporation (Propellex), which merged with Chromalloy Corporation in 1958,²⁴⁵ manufactured propellants and explosive devices; however, it was not determined if those activities occurred at the Refuge.²⁴⁶ In 1964, Chromalloy Corporation received a Canadian patent for “Ammonium nitrate-fuel oil containing triethylene glycol dinitrate.”²⁴⁷ This may have been manufactured and stored at the Refuge.²⁴⁸

Igloo HE-4-1

Igloo HE-4-1 was never built.²⁴⁹

Igloo HE-4-2

Lessee	Dates	Igloo Use
Mine Service Company, Inc./DYNO NOBEL Midwest Inc. <small>250,251,252,253,254,255,256</small> (see discussion following this table)	1976 to present	Storage of electric blasting caps and fuse blasting caps; possibly stored wire product associated with blasting, blasting agents, detonating cord, electronic devices, safety fuses, water gels and nitrostarch dynamite

Mine Service Company, Inc./DYNO NOBEL Midwest Inc.

Using 1988 materials figures as an example of a typical year, Mine Service Company, Inc. (Dyna-Blast, Inc. dba Mine Service, Inc.) estimated they handled the following amounts of hazardous materials at the Refuge: approximately 479,000 lbs of various high explosives,

²⁴⁵ DOI 007408. Propellex’s response to Section 104(e) request for information, Page 1.

²⁴⁶ DOI 007408. Propellex’s response to Section 104(e) request for information, Page 1.

²⁴⁷ DOI 007449. Department of the Secretary of State, Patent and Copyright Office, Canada, Patent Number 692921, dated August 18, 1964.

²⁴⁸ DOI 007409. Propellex’s response to Section 104(e) request for information, Page 2.

²⁴⁹ U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part II, Section 4, Sheet 17.

²⁵⁰ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

²⁵¹ DOI 007300. Mine Service Co., Inc. response to Section 104(e) request for information, dated June 28, 1989, Page 2.

²⁵² DPRA Document Nos. 00018040, 00018042, 00018045, and 00019928. Special Use Permit numbers SUP-54-77, SUP-66-77, SUP-71-78, and SUP-63-79.

²⁵³ DPRA Document No. 00006752. Igloo Lease Contract No. 14-16-0003-81-504 by and between U.S. Fish and Wildlife Service and Mine Service Company, Inc., dated October 1, 1980.

²⁵⁴ DPRA Document No. 00006742. Igloo Lease Contract No. 14-16-0003-91-569 by and between U.S. Fish and Wildlife Service and Dyna-Blast, Inc. d/b/a Mine Service Company, Inc., dated October 1, 1991.

²⁵⁵ DOI 007306. Mine Service Co., Inc., Letter to CONWR informing Refuge that monthly inspections are not necessary in Mine Service’s igloos, dated September 14, 1979.

²⁵⁶ Interview with Mine Service Company representative as noted in TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page 53.

61,000 lbs of detonators, and 134,000 ft of various cords.²⁵⁷ DYNNO NOBEL Midwest, Inc., which is Mine Services' corporate successor, is the current tenant in HE-4-2.²⁵⁸

Igloo HE-4-3

Lessee	Dates	Igloo Use
Universal Match Corporation ^{259,260,261,262}	1956 up to possibly 1964 (see discussion following this table)	Unknown
Olin/Primex/GDO&TS ^{263,264,265,266,267,268}	1970 to present	Explosives storage; Olin stored 30-mm primer in this igloo in 1985

Universal Match Corporation

Universal Match Corporation (UMC) leased 22 igloos in Area 6 from 1956 to 1961 for storage.^{269,270} In 1961, UMC signed a new 3-year lease for up to 32 igloos in Area 6; however, specific igloo numbers were not found.²⁷¹ Another document indicates UMC continued to lease igloos in Area 6 in 1963²⁷² and possibly into 1964.

²⁵⁷ DOI 007300. Mine Service Co., Inc. response to Section 104(e) request for information, dated June 28, 1989, Page 2.

²⁵⁸ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

²⁵⁹ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

²⁶⁰ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

²⁶¹ FWM 001325 – FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

²⁶² FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keep others, dated August 29, 1963.

²⁶³ CRO 001542, CRO 001543, CRO 001544, CRO 001549, CRO 001551, CRO 001553, CRO 001555, CRO 001557. Special Use Permit numbers SUP-88-70, SUP-35-71, SUP-78-72, SUP-81-73, SUP-85-74, SUP-72-75, SUP-74-76, and SUP-52-77. A Special Use Permit was not found for the year 1979 but it is likely that Olin did occupy this igloo at that time.

²⁶⁴ DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

²⁶⁵ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

²⁶⁶ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

²⁶⁷ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

²⁶⁸ PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

²⁶⁹ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

²⁷⁰ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

²⁷¹ FWM 001325 – FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

²⁷² FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keep others, dated August 29, 1963.

Igloo HE-4-4

Lessee	Dates	Igloo Use
Universal Match Corporation ^{273,274,275,276}	1956 up to possibly 1964 (see discussion under HE-4-3)	Unknown
Olin/Primex/GDO&TS ^{277,278,279,280,281,282}	1970 to present	Explosives storage; Olin stored 30-mm primer in this igloo in 1985

Igloo HE-4-5

Lessee	Dates	Igloo Use
Universal Match Corporation ^{283,284,285,286}	1956 up to possibly 1964 (see discussion under HE-4-3)	Unknown
Olin/Primex/GDO&TS ^{287,288,289,290,291,292}	1973 to present	Explosives storage; Olin stored 20-mm and 30-mm RDX in this igloo in 1985

²⁷³ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

²⁷⁴ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

²⁷⁵ FWM 001325 – FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

²⁷⁶ FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keep others, dated August 29, 1963.

²⁷⁷ CRO 001542, CRO 001543, CRO 001544, CRO 001549, CRO 001551, CRO 001553, CRO 001555, CRO 001557. Special Use Permit numbers SUP-88-70, SUP-35-71, SUP-78-72, SUP-81-73, SUP-85-74, SUP-72-75, SUP-74-76, and SUP-52-77. A Special Use Permit was not found for the year 1979, but it is likely that Olin did occupy this igloo at that time.

²⁷⁸ DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

²⁷⁹ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

²⁸⁰ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

²⁸¹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

²⁸² PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

²⁸³ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

²⁸⁴ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

²⁸⁵ FWM 001325 – FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

²⁸⁶ FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keep others, dated August 29, 1963.

²⁸⁷ CRO 001548, CRO 001551, CRO 001553, CRO 001555, CRO 001557. Amendment No. 1, Special Use Permit NO. SUP-81-73, and Special Use Permit numbers SUP-85-74, SUP-72-75, SUP-74-76, and SUP-52-77. A Special Use Permit was not found for the year 1979 but it is likely that Olin did occupy this igloo at that time.

²⁸⁸ DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

Igloo HE-4-6

Lessee	Dates	Igloo Use
Universal Match Corporation ^{293,294,295,296}	1956 up to possibly 1964 (see discussion under HE-4-3)	Unknown
Olin/Primex/GDO&TS ^{297,298,299,300,301,302}	1970 to present	Explosives storage; Olin stored 20-mm and 30-mm RDX in this igloo in 1985

Igloo HE-4-7

Lessee	Dates	Igloo Use
Universal Match Corporation ^{303,304,305,306}	1956 up to possibly 1964 (see discussion under HE-4-3)	Unknown

²⁸⁹ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

²⁹⁰ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

²⁹¹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

²⁹² PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

²⁹³ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

²⁹⁴ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

²⁹⁵ FWM 001325 – FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

²⁹⁶ FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keep others, dated August 29, 1963.

²⁹⁷ CRO 001542, CRO 001543, CRO 001544, CRO 001549, CRO 001551, CRO 001553, CRO 001555, CRO 001557. Special Use Permit numbers SUP-88-70, SUP-35-71, SUP-78-72, SUP-81-73, SUP-85-74, SUP-72-75, SUP-74-76, and SUP-52-77. A Special Use Permit was not found for the year 1979 but it is likely that Olin did occupy this igloo at that time.

²⁹⁸ DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

²⁹⁹ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

³⁰⁰ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

³⁰¹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

³⁰² PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

³⁰³ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

³⁰⁴ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

³⁰⁵ FWM 001325 – FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

³⁰⁶ FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keep others, dated August 29, 1963.

Lessee	Dates	Igloo Use
Trojan Powder Company ³⁰⁷	1964 to 1970	Explosives storage
Wildlife Materials, Inc. ^{308,309,310}	1977 to 1978	As noted above, they stored black powder, M-6 propellant powder and electric squibs in HE-1-10 - it is not known whether similar materials were stored in HE-4-7.
El Dorado Chemical Company ^{311,312,313}	1984 to 1988	Likely storage of ammonium nitrate fertilizer, sulphate of ammonia, and urea fertilizer (see discussion under HE-1-10)
Illinois State Police ³¹⁴	Current tenant (no information was found regarding an initial occupancy date)	Unknown

Igloo HE-4-8

Lessee	Dates	Igloo Use
Universal Match Corporation ^{315,316,317,318}	1956 up to possibly 1964 (see discussion under HE-4-3)	Unknown
Monsanto Company ^{319,320,321,322,323}	1979 to 1983	Storage of ammonium nitrate fertilizers, explosives, sulphate of ammonia, and urea

³⁰⁷ DPRA Document Nos. 00005573, 00005571, 00005568, 00005566, 00005565, and 00005589. Special Use Permit numbers SUP-88-64, SUP-1-66, SUP-3-67, SUP-1-68, SUP-5-70 and a letter from Trojan-U.S. Powder to Fish & Wildlife Service canceling their lease in this building, dated October 1, 1970.

³⁰⁸ DOI 008088. Amendment No. 1 to Special Use Permit SUP-88-76, effective January 1, 1977.

³⁰⁹ DOI 008090. Special Use Permit, Permit number SUP-60-77, dated June 10, 1997.

³¹⁰ DOI 008068 - DOI 008069. Wildlife Materials, Inc.'s response to Section 104(e) request, Pages 2-3.

³¹¹ DPRA Document No. 00006653. Amendment No. 2 to Igloo Lease Contract No. 14-16-0003-83-541, El Dorado Chemical Company, effective August 1, 1984.

³¹² FWM 000942. Amendment No. 3 to Igloo Lease Contract No. 14-16-0003-83-541, El Dorado Chemical Company, effective December 1, 1988.

³¹³ DOI 007368. Monsanto's response to Section 104(e) request, Page 2.

³¹⁴ Industrial Tenant Roster - March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

³¹⁵ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

³¹⁶ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

³¹⁷ FWM 001325 - FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

³¹⁸ FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keep others, dated August 29, 1963.

³¹⁹ DPRA Document No. 00003672. CONWR, Letter to Monsanto Company regarding maintenance items for Monsanto's igloo in Area 6, dated March 28, 1979.

³²⁰ FWM 001034 - FWM 001035. Igloo Lease Contract No. 14-16-0003-81-505 by and between U.S. Fish and Wildlife Service and Monsanto Company, dated October 1, 1980, Page 1 and 1 of 1A.

³²¹ FWM 001037. Amendment No. 1 to Igloo Lease Contract 14-16-0003-81-505, Monsanto Company, effective September 1, 1983.

Lessee	Dates	Igloo Use
El Dorado Chemical Company ^{324,325,326,327}	1983 to 1988	Likely storage of ammonium nitrate fertilizer, sulphate of ammonia, and urea fertilizer (see discussion below)
Olin/Primex/GDO&TS ^{328,329,330,331}	1994 to present	Explosives storage

Monsanto Company/El Dorado Chemical Company

Monsanto Company reportedly occupied igloos throughout the Refuge from 1958 through 1990. El Dorado Chemical Company (EDC) took over Monsanto's lease for HE-4-8 when they bought Monsanto's ammonium nitrate business in 1983, and continued to use this igloo until 1988.^{332,333,334,335} Monsanto was storing ammonium nitrate fertilizer, sulphate of ammonia, and urea fertilizer at the Refuge.³³⁶ EDC likely continued storing the same chemicals in HE-4-8.

Igloo HE-4-9

Lessee	Dates	Igloo Use
Universal Match Corporation ^{337,338,339,340}	1956 up to possibly 1964 (see discussion under HE-4-3)	Unknown

³²² DPRA Document No. 00009342. U.S. Department of the Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Narrative Report, May 1 thru August 31, 1960, Page 25.

³²³ DOI 007368. Monsanto's response to Section 104(e) request, Page 2.

³²⁴ FWM 001040. United States Government Memorandum, CONWR, Consent to Assignment – Monsanto & E.D.C., Inc. – Monsanto – Lease Contract 14-16-0003-81-505, dated August 16, 1983.

³²⁵ DPRA Document No. 00006649. Igloo Lease Contract No. 14-16-0003-83-541 by and between U. S. Fish & Wildlife Service and E.D.C., Incorporated, dated September 1, 1983.

³²⁶ FWM 000942. Amendment No. 3 to Igloo Lease Contract No. 14-16-0003-83-541, El Dorado Chemical Company, effective December 1, 1988.

³²⁷ DOI 007368. Monsanto's response to Section 104(e) request, Page 2.

³²⁸ DPRA Document No. 00007568. Amendment No. 8 to Igloo Lease Contract No. 14-16-0003-81-506, Olin Corporation, effective June 1, 1994.

³²⁹ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

³³⁰ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

³³¹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

³³² FWM 001040. United States Government Memorandum, CONWR, Consent to Assignment – Monsanto & E.D.C., Inc. – Monsanto – Lease Contract 14-16-0003-81-505, dated August 16, 1983.

³³³ DPRA Document No. 00006649. Igloo Lease Contract No. 14-16-0003-83-541 by and between U. S. Fish & Wildlife Service and E.D.C., Incorporated, dated September 1, 1983.

³³⁴ FWM 000942. Amendment No. 3 to Igloo Lease Contract No. 14-16-0003-83-541, El Dorado Chemical Company, effective December 1, 1988.

³³⁵ DOI 007368. Monsanto's response to Section 104(e) request, Page 2.

³³⁶ DOI 007368. Monsanto's response to Section 104(e) request, Page 2.

³³⁷ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

³³⁸ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

Lessee	Dates	Igloo Use
Trojan Powder Company ³⁴¹	1964 to 1970	Explosives storage
Dooley Brothers, Inc. ^{342,343,344}	1971 to 1982	Storage of explosives such as: ANFO P, blasting caps, high-density primers, TOVEX, dynamite and fuses. According to Dooley Brothers, Inc., TOVEX contained the following: "ammonium nitrate, monomethylamine nitrate, water and depending on the grade, sodium nitrate and/or (trace amounts) aluminum."
Hanley Industries ^{345,346,347}	1982 to present	Black powder and high explosives storage

Igloo HE-4-10

Lessee	Dates	Igloo Use
Universal Match Corporation ^{348,349,350,351}	1956 up to possibly 1964 (see discussion under HE-4-3)	Unknown
Trojan Powder Company ³⁵²	1964 to 1967	Explosives storage
Olin/Primex/GDO&TS ^{353,354,355,356,357}	1970 to present	Explosives storage; in 1985, Olin was storing 30-mm propellant in this igloo

³³⁹ FWM 001325 – FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

³⁴⁰ FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keeping others, dated August 29, 1963.

³⁴¹ DPRA Document Nos. 00005573, 00005571, and 00005568. Special Use Permit numbers SUP-88-64, SUP-1-66, and SUP-3-67.

³⁴² DOI 000898 – DOI 000900. Dooley Brothers, Inc., Response to Section 104(e) information request, Pages 1 to 3.

³⁴³ FWM 000914 – FWM 000915. Igloo Lease Contract No. 14-16-0003-81-501 by and between U.S. Fish and Wildlife Service and Dooley Brothers, Inc., dated October 1, 1980.

³⁴⁴ FWM 000917. Amendment No. 1 to Igloo Lease Contract No. 14-16-0003-81-501, effective January 1, 1982.

³⁴⁵ FWM 000980. Amendment No. 2 to Igloo Lease Contract No. 14-16-0003-81-513, Hanley Industries, Inc., effective June 1, 1982.

³⁴⁶ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

³⁴⁷ Interview with Hanley Industries as noted in TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page 53.

³⁴⁸ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

³⁴⁹ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

³⁵⁰ FWM 001325 – FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

³⁵¹ FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keep others, dated August 29, 1963.

³⁵² DPRA Document Nos. 00005573, 00005571, and 00005568. Special Use Permit numbers SUP-88-64, SUP-1-66, and SUP-3-67.

Igloo HE-4-11

Lessee	Dates	Igloo Use
Universal Match Corporation ^{358,359,360,361}	1956 up to possibly 1964 (see discussion under HE-4-3)	Unknown
Trojan Powder Company ³⁶²	1964 to 1967	Explosives storage
Olin/Primex/GDO&TS ^{363,364,365,366,367,368}	1970 to present	Explosives storage; in 1985, Olin was storing 30-mm propellant and other high explosives in this igloo

³⁵³ CRO 001542, CRO 001543, CRO 001544, CRO 001549, CRO 001551, CRO 001553, CRO 001555, CRO 001557. Special Use Permit numbers SUP-88-70, SUP-35-71, SUP-78-72, SUP-81-73, SUP-85-74, SUP-72-75, SUP-74-76, and SUP-52-77. A Special Use Permit was not found for the year 1979 but it is likely that Olin did occupy this igloo at that time.

³⁵⁴ DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

³⁵⁵ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

³⁵⁶ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

³⁵⁷ PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

³⁵⁸ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

³⁵⁹ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

³⁶⁰ FWM 001325 – FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

³⁶¹ FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keep others, dated August 29, 1963.

³⁶² DPRA Document Nos. 00005576, 00005572, 00005571, and 00005568. Special Use Permit numbers SUP-66-64, SUP-2-65, SUP-1-66, and SUP-3-67.

³⁶³ CRO 001542, CRO 001543, CRO 001544, CRO 001549, CRO 001551, CRO 001553, CRO 001555, CRO 001557. Special Use Permit numbers SUP-88-70, SUP-35-71, SUP-78-72, SUP-81-73, SUP-85-74, SUP-72-75, SUP-74-76, and SUP-52-77. A Special Use Permit was not found for the year 1979 but it is likely that Olin did occupy this igloo at that time.

³⁶⁴ DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of 1A.

³⁶⁵ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

³⁶⁶ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

³⁶⁷ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

³⁶⁸ PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

Igloo HE-4-12

Lessee	Dates	Igloo Use
Universal Match Corporation ^{369,370,371,372}	1956 up to possibly 1964 (see discussion under HE-4-3)	Unknown
Trojan Powder Company ³⁷³	1964 to 1967	Explosives storage
U.S. Treasury Department, Bureau of Alcohol, Tobacco, & Firearms ^{374,375}	1973 to 1981; and they are the current tenant in this igloo (it is unknown when they began leasing this igloo again after the 1981 date)	Unspecified materials storage

Igloo HE-5-1

Lessee	Dates	Igloo Use
Universal Match Corporation ^{376,377,378,379}	1956 up to possibly 1962 (see discussion under HE-4-3)	Unknown
Marion Civil Defense/Emergency Service & Disaster Agency/Williamson County Emergency Management Agency ^{380,381,382,383}	1962 to present (see discussion under HE-3-1)	Storage of beds, medical supplies, and food rations

³⁶⁹ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

³⁷⁰ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

³⁷¹ FWM 001325 – FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

³⁷² FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keep others, dated August 29, 1963.

³⁷³ DPRA Document Nos. 00005576, 00005572, 00005571, and 00005568. Special Use Permit numbers SUP-66-64, SUP-2-65, SUP-1-66, and SUP-3-67.

³⁷⁴ DPRA Document No. 00011813, 00011794, and 00011801. Special Use Permit SUP-18-74, Special Use Permit SUP-70-76, and a letter from CONWR to U.S. Treasury Department, Bureau of Alcohol, Tobacco, & Firearms regarding Special Use Permit SUP-09-75 for igloo HE-4-12, dated September 23, 1974. Note, while lease documents were not found for the year 1975, it is likely the Bureau of Alcohol, Tobacco, & Firearms continued to lease this igloo during that time.

³⁷⁵ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

³⁷⁶ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

³⁷⁷ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

³⁷⁸ FWM 001325 – FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

³⁷⁹ FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keep others, dated August 29, 1963.

³⁸⁰ DPRA Document No. 00024805. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, September 1 thru December 31, 1962, Page 32 and Table No. 3 – Industrial Leasing, Revenue & Employment.

Igloo HE-5-2

Lessee	Dates	Igloo Use
Universal Match Corporation ^{384,385,386,387}	1956 up to possibly 1964 (see discussion under HE-4-3)	Unknown
E.I. DuPont DeNemours & Co. ^{388,389,390,391,392}	1978 to 1980 (possibly as early as 1971)	Storage of explosives (TOVEX)
Dooley Brothers, Inc. ^{393,394,395}	1982 to present	Storage of explosives such as: ANFO P, blasting caps, high-density primers, TOVEX, dynamite and fuses

Igloo HE-5-3

Lessee	Dates	Igloo Use
Universal Match Corporation ^{396,397}	1956 to 1961	Unknown

³⁸¹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

³⁸² FWM 000956 – FWM 000957. Igloo Lease, Contract No. 14-16-0003-81-503 by and between U.S. Fish and Wildlife Service and Emergency Service & Disaster Agency, dated October 1, 1980, Page 1 and Page 1 of 1A.

³⁸³ Interview with Mr. Doyle Case of CONWR, as noted in TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page 51.

³⁸⁴ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

³⁸⁵ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

³⁸⁶ FWM 001325 – FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

³⁸⁷ FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keep others, dated August 29, 1963.

³⁸⁸ DOI 001024, DOI 001028, and DOI 001032. Special Use Permit numbers SUP-11-79, SUP-09-80, and one permit marked as Attachment 2-1 (the permit number is illegible).

³⁸⁹ DOI 001008. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 1.

³⁹⁰ DPRA Document No. 00009392. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, 1971, Table No. 1 – Industrial Leasing, Revenue, & Employment.

³⁹¹ DOI 001024, DOI 001028, and DOI 001032. Special Use Permit numbers SUP-11-79, SUP-09-80, and one permit marked as Attachment 2-1 (the permit number is illegible).

³⁹² DOI 001012. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 5.

³⁹³ FWM 000917 – FWM 000918. Amendment No. 1 to Igloo Lease Contract No. 14-16-0003-81-501 Dooley Brothers, Inc., effective January 1, 1982.

³⁹⁴ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

³⁹⁵ DOI 000899. Dooley Brothers, Inc., Response to Section 104(e) information request, Page 2.

³⁹⁶ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

³⁹⁷ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

Lessee	Dates	Igloo Use
Marion Civil Defense/Emergency Service & Disaster Agency/Williamson County Emergency Management Agency ^{398,399,400,401, 402}	1962 to present (see discussion under HE-3-1)	Storage of beds, medical supplies, and food rations

Igloo HE-5-4

Lessee	Dates	Igloo Use
Universal Match Corporation ^{403,404,405,406}	1956 up to possibly 1964 (see discussion under HE-4-3)	Unknown
Olin/Primex/GDO&TS ^{407,408,409,410}	1986 to present	Explosives storage

Igloo HE-5-5

Lessee	Dates	Igloo Use
Universal Match Corporation ^{411,412,413,414}	1956 up to possibly 1964 (see discussion under HE-4-3)	Unknown

³⁹⁸ DPRA Document No. 00024805. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, September 1 thru December 31, 1962, Page 32 and Table No. 3 – Industrial Leasing, Revenue & Employment.

³⁹⁹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁴⁰⁰ FWM 000956 – FWM 000957. Igloo Lease, Contract No. 14-16-0003-81-503 by and between U.S. Fish and Wildlife Service and Emergency Service & Disaster Agency, dated October 1, 1980, Page 1 and Page 1 of 1A.

⁴⁰¹ Interview with Mr. Doyle Case of CONWR, as noted in TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page 51.

⁴⁰² CRO 000231. Refuge files, Table of Industrial Tenants, Crab Orchard National Wildlife Refuge, October, 1990.

⁴⁰³ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

⁴⁰⁴ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

⁴⁰⁵ FWM 001325 – FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

⁴⁰⁶ FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keep others, dated August 29, 1963.

⁴⁰⁷ DOI 001551. Amendment No. 4 to Igloo Lease Contract No. 14-16-0003-81-506, Olin Corporation, effective date December 1, 1986.

⁴⁰⁸ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

⁴⁰⁹ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

⁴¹⁰ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁴¹¹ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

⁴¹² FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

Lessee	Dates	Igloo Use
Austin Powder Company ⁴¹⁵	1979 to 1997	Explosives storage (see discussion under HE-1-12)
Federal Bureau of Investigation (FBI) ⁴¹⁶	Current tenant (it is unknown when the FBI initially leased this igloo)	Unknown

Igloo HE-5-6

Lessee	Dates	Igloo Use
Universal Match Corporation ^{417,418,419,420}	1956 up to possibly 1964 (see discussion under HE-4-3)	Unknown
Dooley Brothers, Inc. ^{421,422,423}	1971 to present	Storage of explosives such as: ANFO P, blasting caps, high-density primers, TOVEX, dynamite and fuses

Igloo HE-5-7

Lessee	Dates	Igloo Use
Universal Match Corporation ^{424,425,426,427}	1956 up to possibly 1964 (see discussion under HE-4-3)	Unknown

⁴¹³ FWM 001325 – FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

⁴¹⁴ FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keep others, dated August 29, 1963.

⁴¹⁵ DOI 000157. Austin Powder's response to Section 104(e) request for information, Page 2.

⁴¹⁶ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁴¹⁷ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

⁴¹⁸ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

⁴¹⁹ FWM 001325 – FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

⁴²⁰ FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keep others, dated August 29, 1963.

⁴²¹ DOI 000898 – DOI 000899. Dooley Brothers, Inc., Response to Section 104(e) information request, Pages 1-2.

⁴²² FWM 000914 – FWM 000915. Igloo Lease Contract No. 14-16-0003-81-501 by and between U. S. Fish and Wildlife Service and Dooley Brothers, Inc., dated October 1, 1980, Pages 1 and Page 1 of Page 1A.

⁴²³ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁴²⁴ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

⁴²⁵ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

⁴²⁶ FWM 001325 – FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

⁴²⁷ FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keep others, dated August 29, 1963.

Lessee	Dates	Igloo Use
Austin Powder Company ⁴²⁸	1979 to 1997	Explosives storage (see discussion under HE-1-12)
Ensign Bickford Industries, Inc. ⁴²⁹	Current tenant (no information was found regarding an initial occupancy date)	Unknown

Igloo HE-5-8

Lessee	Dates	Igloo Use
Universal Match Corporation ^{430,431,432,433}	1956 up to possibly 1964 (see discussion under HE-4-3)	Unknown
Austin Powder Company ⁴³⁴	1979 to 1997	Explosives storage (see discussion under HE-1-12)
Ensign Bickford Industries, Inc. ⁴³⁵	Current tenant (no information was found regarding an initial occupancy date)	Unknown

Igloo HE-5-9

Lessee	Dates	Igloo Use
Universal Match Corporation ^{436,437,438,439}	1956 up to possibly 1964 (see discussion under HE-4-3)	Unknown

⁴²⁸ DOI 000157. Austin Powder's response to Section 104(e) request for information, Page 2.

⁴²⁹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁴³⁰ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

⁴³¹ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

⁴³² FWM 001325 – FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

⁴³³ FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keep others, dated August 29, 1963.

⁴³⁴ DOI 000157. Austin Powder's response to Section 104(e) request for information, Page 2.

⁴³⁵ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁴³⁶ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

⁴³⁷ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

⁴³⁸ FWM 001325 – FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

⁴³⁹ FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keep others, dated August 29, 1963.

Lessee	Dates	Igloo Use
Austin Powder Company ⁴⁴⁰	1979 to 1997	Explosives storage (see discussion under HE-1-12)
Ensign Bickford Industries, Inc. ⁴⁴¹	Current tenant (no information was found regarding an initial occupancy date)	Unknown

Igloo HE-5-10

Lessee	Dates	Igloo Use
Universal Match Corporation ^{442,443,444,445}	1956 up to possibly 1964 see discussion under HE-4-3)	Unknown
Austin Powder Company ⁴⁴⁶	1979 to 1997	Explosives storage (see discussion under HE-1-12)
Ensign Bickford Industries, Inc. ⁴⁴⁷	Current tenant (no information was found regarding an initial occupancy date)	Unknown

Igloo HE-5-11

Lessee	Dates	Igloo Use
Universal Match Corporation ^{448,449,450,451}	1956 up to possibly 1964 (see discussion under HE-4-3)	Unknown

⁴⁴⁰ DOI 000157. Austin Powder's response to Section 104(e) request for information, Page 2.

⁴⁴¹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁴⁴² FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

⁴⁴³ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

⁴⁴⁴ FWM 001325 – FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

⁴⁴⁵ FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keep others, dated August 29, 1963.

⁴⁴⁶ DOI 000157. Austin Powder's response to Section 104(e) request for information, Page 2.

⁴⁴⁷ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁴⁴⁸ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

⁴⁴⁹ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

⁴⁵⁰ FWM 001325 – FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

⁴⁵¹ FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keep others, dated August 29, 1963.

Lessee	Dates	Igloo Use
Austin Powder Company ⁴⁵²	1979 to 1997	Explosives storage (See discussion under HE-1-12)
Ensign Bickford Industries, Inc. ⁴⁵³	Current tenant (no information was found regarding an initial occupancy date)	Unknown

Igloo HE-5-12

Lessee	Dates	Igloo Use
Universal Match Corporation ^{454,455,456,457}	1956 up to possibly 1962 (see discussion under HE-4-3)	Unknown
Marion Civil Defense/Emergency Service & Disaster Agency/Williamson County Emergency Management Agency ^{458,459,460,461, 462}	1962 to present (see discussion under HE-3-1)	Storage of beds, medical supplies, and food rations

⁴⁵² DOI 000157. Austin Powder's response to Section 104(e) request for information, Page 2.

⁴⁵³ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁴⁵⁴ FWM 001316. Lease Contract No. 14-19-0003-2631 by and between Universal Match Corporation and the U.S. Department of the Interior, Fish and Wildlife Service, dated February 14, 1956.

⁴⁵⁵ FWM 001321. Amendment No. 2 to Lease Contract No. 14-19-003-2631, dated December 17, 1956.

⁴⁵⁶ FWM 001325 – FWM 001326. Lease Contract No. 14-16-0003-3592, Universal Match Corporation, dated April 3, 1961, Pages 1-2.

⁴⁵⁷ FWM 001329. Unidynamics, Letter to CONWR regarding terminating some buildings under their lease contract and keep others, dated August 29, 1963.

⁴⁵⁸ DPRA Document No. 00024805. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, September 1 thru December 31, 1962, Page 32 and Table No. 3 – Industrial Leasing, Revenue & Employment.

⁴⁵⁹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁴⁶⁰ FWM 000956 – FWM 000957. Igloo Lease, Contract No. 14-16-0003-81-503 by and between U.S. Fish and Wildlife Service and Emergency Service & Disaster Agency, dated October 1, 1980, Page 1 and Page 1 of 1A.

⁴⁶¹ Interview with Mr. Doyle Case of CONWR, as noted in TechLaw, Inc., 1992, Final Draft Report, Site Operations/Ownership History, Crab Orchard National Wildlife Refuge, Page 51.

⁴⁶² CRO 000231. Refuge files, Table of Industrial Tenants, Crab Orchard National Wildlife Refuge, October, 1990.

Igloo HE-6-1

Lessee	Dates	Igloo Use
Sangamo Electric Company (later Sangamo Westin, Inc., later Schlumberger Industries, Inc.) ^{463,464,465,466}	1956 to 1962 (this conflicts with documents indicating Petrof Trading Company used this igloo from as early as 1961)	Unknown
Petrof Trading Company ^{467,468}	1961 to 1966	Storage of smokeless powder
Mine Service Company, Inc./DYNO NOBEL Midwest Inc. ^{469,470,471,472,473,474}	1976 to present	Wire products associated with blasting, as well as, dry product (explosive) (also see discussion under HE-4-1)

Petrof Trading Company

According to a newspaper report, Petrof Trading Company stored more than six million lbs of smokeless powder in Area 13.⁴⁷⁵ Whether this information is reliable (or which igloos may have been used) is not known.

⁴⁶³ FWM 001253 – FWM 001254. Lease Contract No. 14-19-003-2694, Lands Designation M-22 by and between Sangamo Electric Company and the U. S. Department of the Interior, Fish and Wildlife Service, dated September 1, 1956, Pages 1-2.

⁴⁶⁴ FWM 001260 – FWM 001261. Lease Contract No. 14-16-0003-4751, Lands Designation M-22 by and between Sangamo Electric Company and the U. S. Department of the Interior, Fish and Wildlife Service, dated September 1, 1961, Pages 1-2.

⁴⁶⁵ DOI 007714. USDO, Letter to Sangamo Electric Company regarding cancellation of Lease Contract No. 14-16-0003-4751, dated March 20, 1962.

⁴⁶⁶ CRO 000486. Lease Contract No. 14-16-0003-4730 by and between U. S. Fish and Wildlife Service and Petrof Trading Company, Inc., dated December 1, 1961, Page 1.

⁴⁶⁷ CRO 000486. Lease Contract No. 14-16-0003-4730 by and between U. S. Fish and Wildlife Service and Petrof Trading Company, Inc., dated December 1, 1961, Page 1.

⁴⁶⁸ CRO 001595 B. Newspaper article from the Southern Illinoisian, dated April 24, 1962.

⁴⁶⁹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁴⁷⁰ DOI 007300. Mine Service Co., Inc. response to Section 104(e) request for information, dated June 28, 1989, Page 2.

⁴⁷¹ DPRA Document Nos. 00018045, and 00019928. Special Use Permit numbers SUP-71-78, and SUP-63-79.

⁴⁷² DPRA Document No. 00006752. Igloo Lease Contract No. 14-16-0003-81-504 by and between U.S. Fish and Wildlife Service and Mine Service Company, Inc., dated October 1, 1980.

⁴⁷³ DPRA Document No. 00006742. Igloo Lease Contract No. 14-16-0003-91-569 by and between U.S. Fish and Wildlife Service and Dyna-Blast, Inc. d/b/a Mine Service Company, Inc., dated October 1, 1991.

⁴⁷⁴ DOI 007306. Mine Service Co., Inc., Letter to CONWR informing Refuge that monthly inspections are not necessary in Mine Service's igloos, dated September 14, 1979.

⁴⁷⁵ CRO 001595 B. Newspaper article from the Southern Illinoisian, dated April 24, 1962.

Igloo HE-6-2

Lessee	Dates	Igloo Use
Petrof Trading Company ^{476,477}	1961 to 1966	Storage of smokeless powder
Mine Service Company, Inc./DYNO NOBEL Midwest Inc. 478,479,480,481,482,483	1976 to present	Detonating cord, electronic devices, and safety fuses (also see discussion under HE-4-1)

Igloo HE-6-3

Lessee	Dates	Igloo Use
Petrof Trading Company ^{484,485}	1961 to 1966	Storage of smokeless powder
Olin/Primex/GDO&TS ^{486,487,488,489}	1995 to present	Explosives storage

Igloo HE-6-4

Lessee	Dates	Igloo Use
Petrof Trading Company ^{490,491}	1961 to 1966	Storage of smokeless powder

⁴⁷⁶ CRO 000486. Lease Contract No. 14-16-0003-4730 by and between U. S. Fish and Wildlife Service and Petrof Trading Company, Inc., dated December 1, 1961, Page 1.

⁴⁷⁷ CRO 001595 B. Newspaper article from the Southern Illinoisian, dated April 24, 1962.

⁴⁷⁸ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁴⁷⁹ DOI 007300. Mine Service Co., Inc. response to Section 104(e) request for information, dated June 28, 1989, Page 2.

⁴⁸⁰ DPRA Document Nos. 00018045, and 00019928. Special Use Permit numbers SUP-71-78, and SUP-63-79.

⁴⁸¹ DPRA Document No. 00006752. Igloo Lease Contract No. 14-16-0003-81-504 by and between U.S. Fish and Wildlife Service and Mine Service Company, Inc., dated October 1, 1980.

⁴⁸² DPRA Document No. 00006742. Igloo Lease Contract No. 14-16-0003-91-569 by and between U.S. Fish and Wildlife Service and Dyna-Blast, Inc. d/b/a Mine Service Company, Inc., dated October 1, 1991.

⁴⁸³ DOI 007306. Mine Service Co., Inc., Letter to CONWR informing Refuge that monthly inspections are not necessary in Mine Service's igloos, dated September 14, 1979.

⁴⁸⁴ CRO 000486. Lease Contract No. 14-16-0003-4730 by and between U. S. Fish and Wildlife Service and Petrof Trading Company, Inc., dated December 1, 1961, Page 1.

⁴⁸⁵ CRO 001595 B. Newspaper article from the Southern Illinoisian, dated April 24, 1962.

⁴⁸⁶ DPRA Document No. 00007571. Amendment No. 9 to Igloo Lease Contract No. 14-16-0003-81-506, Olin Corporation, effective February 1, 1995.

⁴⁸⁷ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., effective January 1, 1997.

⁴⁸⁸ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

⁴⁸⁹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁴⁹⁰ CRO 000486. Lease Contract No. 14-16-0003-4730 by and between U. S. Fish and Wildlife Service and Petrof Trading Company, Inc., dated December 1, 1961, Page 1.

⁴⁹¹ CRO 001595 B. Newspaper article from the Southern Illinoisian, dated April 24, 1962.

Lessee	Dates	Igloo Use
E.I. DuPont DeNemours & Co. ^{492,493,494,495}	1978 to 1980 (possibly as early as 1971)	Storage of explosives (TOVEX)
Olin/Primex/GDO&TS ^{496,497,498,499}	1994 to present	Explosives storage

Igloo HE-6-5

Lessee	Dates	Igloo Use
Petrof Trading Company ^{500,501}	1961 to 1966	Storage of smokeless powder
E.I. DuPont DeNemours & Co. ^{502,503,504,505}	1978 to 1980 (possibly as early as 1971)	Storage of explosives (TOVEX)
Olin/Primex/GDO&TS ^{506,507,508,509}	1987 to present	Explosives storage

⁴⁹² DOI 001024, DOI 001028, and DOI 001032. Special Use Permit numbers SUP-11-79, SUP-09-80, and one permit marked as Attachment 2-1 (the permit number is illegible).

⁴⁹³ DOI 001008. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 1.

⁴⁹⁴ DPRA Document No. 00009392. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, 1971, Table No. 1 – Industrial Leasing, Revenue, & Employment.

⁴⁹⁵ DOI 001012. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 5.

⁴⁹⁶ DPRA Document No. 00007568. Amendment No. 8 to Igloo Lease Contract No. 14-16-0003-81-506, Olin Corporation, effective June 1, 1994.

⁴⁹⁷ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., effective January 1, 1997.

⁴⁹⁸ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

⁴⁹⁹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁵⁰⁰ CRO 000486. Lease Contract No. 14-16-0003-4730 by and between U. S. Fish and Wildlife Service and Petrof Trading Company, Inc., dated December 1, 1961, Page 1.

⁵⁰¹ CRO 001595 B. Newspaper article from the Southern Illinoisian, dated April 24, 1962.

⁵⁰² DOI 001024, DOI 001028, and DOI 001032. Special Use Permit numbers SUP-11-79, SUP-09-80, and one permit marked as Attachment 2-1 (the permit number is illegible).

⁵⁰³ DOI 001008. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 1.

⁵⁰⁴ DPRA Document No. 00009392. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, 1971, Table No. 1 – Industrial Leasing, Revenue, & Employment.

⁵⁰⁵ DOI 001012. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 5.

⁵⁰⁶ DPRA Document No. 00007563. Amendment No. 5 to Igloo Lease Contract No. 14-16-0003-81-506, Olin Corporation, effective March 1, 1987.

⁵⁰⁷ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

⁵⁰⁸ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

⁵⁰⁹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Igloo HE-6-6

Lessee	Dates	Igloo Use
Petrof Trading Company ^{510,511}	1961 to 1966	Storage of smokeless powder
E.I. DuPont DeNemours & Co. ^{512, 513,514,515}	1978 to 1980 (possibly as early as 1971)	Storage of explosives (TOVEX)
Olin/Primex/GDO&TS ^{516,517,518,519}	1987 to present	Explosives storage

Igloo HE-6-7

Lessee	Dates	Igloo Use
Petrof Trading Company ^{520,521}	1961 to 1966	Storage of smokeless powder
E.I. DuPont DeNemours & Co. ^{522,523,524,525}	1978 to 1980 (possibly as early as 1971)	Storage of explosives (TOVEX)
Olin/Primex/GDO&TS ^{526,527,528,529}	1987 to present	Explosives storage

⁵¹⁰ CRO 000486. Lease Contract No. 14-16-0003-4730 by and between U. S. Fish and Wildlife Service and Petrof Trading Company, Inc., dated December 1, 1961, Page 1.

⁵¹¹ CRO 001595 B. Newspaper article from the Southern Illinoisian, dated April 24, 1962.

⁵¹² DOI 001024, DOI 001028, and DOI 001032. Special Use Permit numbers SUP-11-79, SUP-09-80, and one permit marked as Attachment 2-1 (the permit number is illegible).

⁵¹³ DOI 001008. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 1.

⁵¹⁴ DPRA Document No. 00009392. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, 1971, Table No. 1 – Industrial Leasing, Revenue, & Employment.

⁵¹⁵ DOI 001012. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 5.

⁵¹⁶ DPRA Document No. 00007563. Amendment No. 5 to Igloo Lease Contract No. 14-16-0003-81-506, Olin Corporation, effective March 1, 1987.

⁵¹⁷ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

⁵¹⁸ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

⁵¹⁹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁵²⁰ CRO 000486. Lease Contract No. 14-16-0003-4730 by and between U. S. Fish and Wildlife Service and Petrof Trading Company, Inc., dated December 1, 1961, Page 1.

⁵²¹ CRO 001595 B. Newspaper article from the Southern Illinoisian, dated April 24, 1962.

⁵²² DOI 001024, DOI 001028, and DOI 001032. Special Use Permit numbers SUP-11-79, SUP-09-80, and one permit marked as Attachment 2-1 (the permit number is illegible).

⁵²³ DOI 001008. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 1.

⁵²⁴ DPRA Document No. 00009392. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, 1971, Table No. 1 – Industrial Leasing, Revenue, & Employment.

⁵²⁵ DOI 001012. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 5.

⁵²⁶ DPRA Document No. 00007563. Amendment No. 5 to Igloo Lease Contract No. 14-16-0003-81-506, Olin Corporation, effective March 1, 1987.

Igloo HE-6-8

Lessee	Dates	Igloo Use
Petrof Trading Company ^{530,531}	1961 to 1966	Storage of smokeless powder
Southern Illinois University ⁵³²	1977 to 1978	Unspecified storage
Austin Powder Company ^{533,534,535}	1979 to 1997	Explosives storage (see discussion under HE-1-12)
Ensign Bickford Industries, Inc. ⁵³⁶	Current tenant (no information was found regarding an initial occupancy date)	Unknown

Igloo HE-6-9

Lessee	Dates	Igloo Use
Petrof Trading Company ^{537,538}	1961 to 1966	Storage of smokeless powder
Southern Illinois University ⁵³⁹	1977 to 1978	Unspecified storage
Austin Powder Company ^{540,541,542}	1979 to 1997	Explosives storage (see discussion under HE-1-12)

⁵²⁷ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

⁵²⁸ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

⁵²⁹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁵³⁰ CRO 000486. Lease Contract No. 14-16-0003-4730 by and between U. S. Fish and Wildlife Service and Petrof Trading Company, Inc., dated December 1, 1961, Page 1.

⁵³¹ CRO 001595 B. Newspaper article from the Southern Illinoisian, dated April 24, 1962.

⁵³² DPRA Document No. 00027299. Special Use Permit SUP-59-77.

⁵³³ DPRA Document No. 00003704. Fish and Wildlife Service, Letter to Austin Powder Company regarding maintenance items required for leased igloos in Area 6, dated March 28, 1979.

⁵³⁴ DOI 000164 – DOI 000165. Igloo Lease Contract No. 14-16-0003-81-500 by and between U.S. Fish and Wildlife Service and Austin Powder Company, dated October 1, 1980, Page 1 and Page 1 of Page 1A.

⁵³⁵ CRO 000231. Refuge files, Table of Industrial Tenants, Crab Orchard National Wildlife Refuge, October, 1990.
⁵³⁶ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁵³⁷ CRO 000486. Lease Contract No. 14-16-0003-4730 by and between U. S. Fish and Wildlife Service and Petrof Trading Company, Inc., dated December 1, 1961, Page 1.

⁵³⁸ CRO 001595 B. Newspaper article from the Southern Illinoisian, dated April 24, 1962.

⁵³⁹ DPRA Document No. 00027299. Special Use Permit SUP-59-77.

⁵⁴⁰ DPRA Document No. 00003704. Fish and Wildlife Service, Letter to Austin Powder Company regarding maintenance items required for leased igloos in Area 6, dated March 28, 1979.

⁵⁴¹ DOI 000164 – DOI 000165. Igloo Lease Contract No. 14-16-0003-81-500 by and between U.S. Fish and Wildlife Service and Austin Powder Company, dated October 1, 1980, Page 1 and Page 1 of Page 1A.

⁵⁴² CRO 000231. Refuge files, Table of Industrial Tenants, Crab Orchard National Wildlife Refuge, October, 1990.

Lessee	Dates	Igloo Use
Ensign Bickford Industries, Inc. ⁵⁴³	Current tenant (no information was found regarding an initial occupancy date)	Unknown

Igloo HE-6-10

Lessee	Dates	Igloo Use
Petrof Trading Company ^{544,545}	1961 to 1966	Storage of smokeless powder
Southern Illinois University ⁵⁴⁶	1977 to 1978	Unspecified storage
Austin Powder Company ^{547,548,549}	1979 to 1997	Explosives storage (see discussion under HE-1-12)
Ensign Bickford Industries, Inc. ⁵⁵⁰	Current tenant (no information was found regarding an occupancy date)	Unknown

Igloo HE-6-11

Lessee	Dates	Igloo Use
Petrof Trading Company ⁵⁵¹	1970 to 1971	Storage of smokeless powder
Jupiter Blasting ⁵⁵²	1971 to 1975	Explosives storage
Mine Service Company, Inc./DYNO NOBEL Midwest Inc. <small>553,554,555,556,557,558</small>	1976 to present	Water gels and nitrostarch dynamite (dry powder) (also see discussion under HE-4-1)

⁵⁴³ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁵⁴⁴ CRO 000486. Lease Contract No. 14-16-0003-4730 by and between U. S. Fish and Wildlife Service and Petrof Trading Company, Inc., dated December 1, 1961, Page 1.

⁵⁴⁵ CRO 001595 B. Newspaper article from the Southern Illinoisian, dated April 24, 1962.

⁵⁴⁶ DPRA Document No. 00027299. Special Use Permit SUP-59-77.

⁵⁴⁷ DPRA Document No. 00003704. Fish and Wildlife Service, Letter to Austin Powder Company regarding maintenance items required for leased igloos in Area 6, dated March 28, 1979.

⁵⁴⁸ DOI 000164 – DOI 000165. Igloo Lease Contract No. 14-16-0003-81-500 by and between U.S. Fish and Wildlife Service and Austin Powder Company, dated October 1, 1980, Page 1 and Page 1 of Page 1A.

⁵⁴⁹ CRO 000231. Refuge files, Table of Industrial Tenants, Crab Orchard National Wildlife Refuge, October, 1990.

⁵⁵⁰ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁵⁵¹ CRO 001564. Special Use Permit SUP-49-70.

⁵⁵² CRO 001645 – CRO 001649. Special Use Permit numbers SUP-42-72, SUP-55-72, SUP-11-73, SUP-48-74, and SUP-18-75.

Igloo HE-6-12

Igloo HE-6-12 was never built.

Transfer Platform HE-6-13

SWDC/War Department used this transfer platform from 1942 through 1945. It is possible that post-World War II tenants from Area 6 who are listed in Table 10-1 below, also used this loading/unloading platform. It is likely that this platform was used by those tenants that occupied the center row of Area 6 (Igloos HE-4-1 through HE-4-12), since both are along the rail line.

Igloo HE-7-1

Lessee	Dates	Igloo Use
Olin/Primex/GDO&TS ^{559,560,561,,562,563}	1972 to present	Storage of ordnance explosives and hazardous "MT" waste

Olin

A 1977 Olin safety audit considered this igloo a safety hazard because fuels and oxidizers were being housed together and there was spillage on the floor. Olin also noted that fuses, NG scrap, and ammonium perchlorate were stored together in this igloo.⁵⁶⁴

⁵⁵³ DOI 007300. Mine Service Co., Inc. response to Section 104(e) request for information, dated June 28, 1989, Page 2.

⁵⁵⁴ DPRA Document Nos. 00018038, 00018042, 00018045, and 00019928. Special Use Permit numbers SUP-95-76, SUP-66-77, SUP-71-78, and SUP-63-79.

⁵⁵⁵ DPRA Document No. 00006752. Igloo Lease Contract No. 14-16-0003-81-504 by and between U.S. Fish and Wildlife Service and Mine Service Company, Inc., dated October 1, 1980.

⁵⁵⁶ DPRA Document No. 00006742. Igloo Lease Contract No. 14-16-0003-91-569 by and between U.S. Fish and Wildlife Service and Dyna-Blast, Inc. d/b/a Mine Service Company, Inc., dated October 1, 1991.

⁵⁵⁷ DOI 007306. Mine Service Co., Inc., Letter to CONWR informing Refuge that monthly inspections are not necessary in Mine Service's igloos, dated September 14, 1979.

⁵⁵⁸ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁵⁵⁹ CRO 001545, CRO 001550, CRO 001552, CRO 001554, CRO 001562, CRO 001558, CRO 001559, and CRO 001561. Special Use Permit numbers SUP-12-73, SUP-12-74, SUP-12-75, SUP-14-76, SUP-102-76, SUP-10-78, SUP-04-79, and SUP-03-80.

⁵⁶⁰ DPRA Document No. 00007546. Igloo Lease, Contract No. 14-16-0003-81-506, by and between U.S. Fish and Wildlife Service and Olin Corporation, dated October 1, 1980, Page 1 and Page 1 of IA.

⁵⁶¹ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., dated January 1, 1997.

⁵⁶² Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁵⁶³ PRI-00468. From the Olin files, an attachment to a letter from FWS regarding required maintenance items for igloos in Area 6, dated May 2, 1985. The attachment is a list of materials Olin is storing in igloos on the refuge.

⁵⁶⁴ DPRA Document No. 00015490/PRI-006673 – PRI-006674. Olin, Inter Office Memo entitled "Quarterly Safety Audit, Warehouses and Igloos, dated October 12, 1977, Pages 1-2. Note, when referring to igloos in Area 6, Olin often used the prefix "6" for their igloo numbers, which indicated Area 6, e.g., HE-7-1 is referred to as 6-7-1.

Igloo HE-7-2

Lessee	Dates	Igloo Use
E.I. DuPont DeNemours & Co. ^{565,566,567,568}	1978 to 1980 (possibly as early as 1971)	Storage of explosives (TOVEX)
Sontec Company (a blasting products company) ^{569,570,571}	1985 to 1986	Explosives storage
Propellex ^{572,573,574,575}	1987 to present	Likely storage of propellants, explosive devices, and ammonium nitrate-fuel oil containing triethylene glycol dinitrate

Igloo HE-7-3

Lessee	Dates	Igloo Use
E.I. DuPont DeNemours & Co. ^{576,577,578,579}	1978 to 1980 (possibly as early as 1971)	Storage of explosives (TOVEX)
Sontec Company ^{580,581}	1985 to 1986	Explosives storage

⁵⁶⁵ DOI 001024, DOI 001028, and DOI 001032. Special Use Permit numbers SUP-11-79, SUP-09-80, and one permit marked as Attachment 2-1 (the permit number is illegible).

⁵⁶⁶ DOI 001008. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 1.

⁵⁶⁷ DPRA Document No. 00009392. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, 1971, Table No. 1 – Industrial Leasing, Revenue, & Employment.

⁵⁶⁸ DOI 001012. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 5.

⁵⁶⁹ DPRA Document No. 00003170. CONWR, Letter to Sontec Company enclosing copies of Amendment No. 1 to Lease Contract No. 14-16-0003-85-551, dated December 17, 1986.

⁵⁷⁰ CRO 000530 – CRO 000231. Igloo Lease Contract No. 14-16-0003-85-551 by and between U. S. Fish and Wildlife Service and Sontec Company, dated May 1, 1985, Pages 1-2.

⁵⁷¹ DPRA Document No. 00003038. Amendment No. 1 to Igloo Lease No. 14-16-0003-85-551, Sontec Company, effective January 1, 1987.

⁵⁷² FWM 001245 - FWM 001246. Igloo Lease Contract No. 14-16-0003-87-557 by and between U. S. Fish and Wildlife Service and Propellex Corporation, dated January 1, 1987, Pages 1-2.

⁵⁷³ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁵⁷⁴ DOI 007408 – DOI 007409. Propellex's response to Section 104(e) request for information, Pages 1-2.

⁵⁷⁵ DOI 007449. Department of the Secretary of State, Patent and Copyright Office, Canada, Patent Number 692921, dated August 18, 1964.

⁵⁷⁶ DOI 001024, DOI 001028, and DOI 001032. Special Use Permit numbers SUP-11-79, SUP-09-80, and one permit marked as Attachment 2-1 (the permit number is illegible).

⁵⁷⁷ DOI 001008. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 1.

⁵⁷⁸ DPRA Document No. 00009392. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, 1971, Table No. 1 – Industrial Leasing, Revenue, & Employment.

⁵⁷⁹ DOI 001012. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 5.

⁵⁸⁰ CRO 000530 – CRO 000231. Igloo Lease Contract No. 14-16-0003-85-551 by and between U. S. Fish and Wildlife Service and Sontec Company, dated May 1, 1985, Pages 1-2.

Lessee	Dates	Igloo Use
Propellex ^{582,583,584,585}	1987 to present	Likely storage of propellants, explosive devices, and ammonium nitrate-fuel oil containing triethylene glycol dinitrate

Igloo HE-7-4

Igloo HE-7-4 was never built.⁵⁸⁶

Igloo HE-7-5

Igloo HE-7-5 was never built.⁵⁸⁷

Igloo HE-7-6

Lessee	Dates	Igloo Use
E.I. DuPont DeNemours & Co. ^{588,589,590,591}	1978 to 1980 (possibly as early as 1971)	Storage of explosives (TOVEX)
Olin/Primex/GDO&TS ^{592,593,594,595}	1987 to present	Explosives storage

⁵⁸¹ DPRA Document No. 00003038. Amendment No. 1 to Igloo Lease No. 14-16-0003-85-551, Sontec Company, effective January 1, 1987.

⁵⁸² FWM 001245 - FWM 001246. Igloo Lease Contract No. 14-16-0003-87-557 by and between U. S. Fish and Wildlife Service and Propellex Corporation, dated January 1, 1987, Pages 1-2.

⁵⁸³ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁵⁸⁴ DOI 007408 – DOI 007409. Propellex’s response to Section 104(e) request for information, Pages 1-2.

⁵⁸⁵ DOI 007449. Department of the Secretary of State, Patent and Copyright Office, Canada, Patent Number 692921, dated August 18, 1964.

⁵⁸⁶ U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part II, Section 4, Sheet 17.

⁵⁸⁷ U.S. Army Corps of Engineers, 1944, War Department Facilities Inventory of the Illinois Ordnance Plant Carbondale, Illinois, Part II, Section 4, Sheet 17.

⁵⁸⁸ DOI 001024, DOI 001028, and DOI 001032. Special Use Permit numbers SUP-11-79, SUP-09-80, and one permit marked as Attachment 2-1 (the permit number is illegible).

⁵⁸⁹ DOI 001008. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 1.

⁵⁹⁰ DPRA Document No. 00009392. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, 1971, Table No. 1 – Industrial Leasing, Revenue, & Employment.

⁵⁹¹ DOI 001012. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 5.

⁵⁹² DPRA Document No. 00007563. Amendment No. 5 to Igloo Lease Contract No. 14-16-0003-81-506, Olin Corporation, effective March 1, 1987.

⁵⁹³ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., effective January 1, 1997.

⁵⁹⁴ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

⁵⁹⁵ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Igloo HE-7-7

Lessee	Dates	Igloo Use
E.I. DuPont DeNemours & Co. ^{596,597,598,599}	1978 to 1980 (possibly as early as 1971)	Storage of explosives (TOVEX)
Olin/Primex/GDO&TS ^{600,601,602,603}	1987 to present	Explosives storage

Igloo HE-7-8

Lessee	Dates	Igloo Use
E.I. DuPont DeNemours & Co. 604,605,606,607	1978 to 1980 (possibly as early as 1971)	Storage of explosives (TOVEX)
Olin/Primex/GDO&TS ^{608,609,610,611}	1987 to present	Explosives storage

⁵⁹⁶ DOI 001024, DOI 001028, and DOI 001032. Special Use Permit numbers SUP-11-79, SUP-09-80, and one permit marked as Attachment 2-1 (the permit number is illegible).

⁵⁹⁷ DOI 001008. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 1.

⁵⁹⁸ DPRA Document No. 00009392. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, 1971, Table No. 1 – Industrial Leasing, Revenue, & Employment.

⁵⁹⁹ DOI 001012. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 5.

⁶⁰⁰ DPRA Document No. 00007568. Amendment No. 8 to Igloo Lease Contract No. 14-16-0003-81-506, Olin Corporation, effective June 1, 1994.

⁶⁰¹ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., effective January 1, 1997.

⁶⁰² DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

⁶⁰³ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁶⁰⁴ DOI 001024, DOI 001028, and DOI 001032. Special Use Permit numbers SUP-11-79, SUP-09-80, and one permit marked as Attachment 2-1 (the permit number is illegible).

⁶⁰⁵ DOI 001008. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 1.

⁶⁰⁶ DPRA Document No. 00009392. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, 1971, Table No. 1 – Industrial Leasing, Revenue, & Employment.

⁶⁰⁷ DOI 001012. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 5.

⁶⁰⁸ DPRA Document No. 00007568. Amendment No. 8 to Igloo Lease Contract No. 14-16-0003-81-506, Olin Corporation, effective June 1, 1994.

⁶⁰⁹ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., effective January 1, 1997.

⁶¹⁰ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

⁶¹¹ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

Igloo HE-7-9

Lessee	Dates	Igloo Use
E.I. DuPont DeNemours & Co. ^{612,613,614,615}	1978 to 1980 (possibly as early as 1971)	Storage of explosives (TOVEX)
Circle R Powder and Explosive Co. ^{616,617,618}	1986 to 1991	Explosives storage
Olin/Primex/GDO&TS ^{619,620,621,622}	1994 to present	Explosives storage

Igloo HE-7-10

Lessee	Dates	Igloo Use
E.I. DuPont DeNemours & Co. ^{623,624,625,626}	1978 to 1980 (possibly as early as 1971)	Storage of explosives (TOVEX)
Dooley Brothers, Inc. ^{627,628,629}	1982 to present	Storage of explosives such as ANFO P, blasting caps, high-density primers, TOVEX, dynamite and fuses

⁶¹² DOI 001024, DOI 001028, and DOI 001032. Special Use Permit numbers SUP-11-79, SUP-09-80, and one permit marked as Attachment 2-1 (the permit number is illegible).

⁶¹³ DOI 001008. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 1.

⁶¹⁴ DPRA Document No. 00009392. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, 1971, Table No. 1 – Industrial Leasing, Revenue, & Employment.

⁶¹⁵ DOI 001012. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 5.

⁶¹⁶ FWM 000882 – FWM 000883. Igloo Lease Contract No. 14-16-0003-86-556 by and between U.S. Fish and Wildlife Service and Circle R Powder and Explosive Company, dated November 1, 1986, Pages 1-2.

⁶¹⁷ CRO 000231. Refuge files, Table of Industrial Tenants, Crab Orchard National Wildlife Refuge, October, 1990.

⁶¹⁸ DPRA Document No. 00006569. Amendment No. 2 to Igloo Lease Contract No. 14-16-0003-86-556U, effective July 1, 1991.

⁶¹⁹ DPRA Document No. 00007568. Amendment No. 8 to Igloo Lease Contract No. 14-16-0003-81-506, Olin Corporation, effective June 1, 1994.

⁶²⁰ DPRA Document No. 00007583. Amendment No. 11 to Igloo Lease Contract No. 14-16-0003-81-506, Primex Technologies, Inc., effective January 1, 1997.

⁶²¹ DPRA Document No. 00007524. Building and Igloo Lease, Contract No. 14-16-0003-96-579, by and between U.S. Fish and Wildlife Service and Primex Technologies, Inc., dated January 1, 1997, Pages 1, 8 and 10.

⁶²² Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁶²³ DOI 001024, DOI 001028, and DOI 001032. Special Use Permit numbers SUP-11-79, SUP-09-80, and one permit marked as Attachment 2-1 (the permit number is illegible).

⁶²⁴ DOI 001008. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 1.

⁶²⁵ DPRA Document No. 00009392. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, 1971, Table No. 1 – Industrial Leasing, Revenue, & Employment.

⁶²⁶ DOI 001012. E.I du Pont de Nemours and Co., First Set of Information Requests, Crab Orchard National Wildlife Refuge NPL Site, dated August 3, 1989, Page 5.

⁶²⁷ FWM 000917. Amendment No. 1 to Igloo Lease Contract No. 14-16-0003-81-501, Dooley Brothers, Inc., effective January 1, 1982.

Igloo HE-7-11

Lessee	Dates	Igloo Use
Dooley Brothers, Inc. ^{630,631,632,633,634}	1971 to present	Storage of explosives such as ANFO P, blasting caps, high-density primers, TOVEX, dynamite and fuses

Dooley Brothers, Inc.

In their 1989 CERCLA Section 104(e) response, Dooley Brothers, Inc. indicated they buried explosive materials next to Igloos HE-7-11 and HE-7-12 on two occasions, with the permission of Refuge staff.⁶³⁵ These buried materials included "Tovex 100, MS-5 Primacord Connectors, Ignitacord, and MS-75 Primadet and MS-100 Primadet."⁶³⁶ According to DuPont, TOVEX contained the following: "ammonium nitrate, monomethylamine nitrate, water and depending on the grade, sodium nitrate and/or (trace amounts) aluminum."⁶³⁷

Igloo HE-7-12

Lessee	Dates	Igloo Use
Dooley Brothers, Inc. ^{638,639,640,641,642}	1971 to present	Storage of explosives such as ANFO P, blasting caps, high-density primers, TOVEX, dynamite and fuses

Dooley Brothers, Inc.

See discussion under Igloo HE-7-11.

⁶²⁸ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁶²⁹ DOI 000898 – DOI 000899. Dooley Brothers, Inc., Response to Section 104(e) information request, Pages 1-2.

⁶³⁰ DOI 000898. Dooley Brothers, Inc., Response to Section 104(e) information request, Page 1.

⁶³¹ CRO 000134. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, 1971, Table No. 1 – Industrial Leasing, Revenue, & Employment.

⁶³² FWM 000914 – FWM 000915. Igloo Lease Contract No. 14-16-0003-81-501 by and between U. S. Fish and Wildlife Service and Dooley Brothers, Inc., dated October 1, 1980 Page 1 and Page 1 of 1A.

⁶³³ DOI 000898. Dooley Brothers, Inc., Response to Section 104(e) information request, Page 1.

⁶³⁴ Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

⁶³⁵ DOI 000900. Dooley Brothers, Inc., Response to Section 104(e) information request, Page 3.

⁶³⁶ DOI 000921. Dooley Bros., Delivery Ticket, DT-B 00695 for explosives destroyed, dated April 27, 1979.

⁶³⁷ DOI 001012.

⁶³⁸ DOI 000898. Dooley Brothers, Inc., Response to Section 104(e) information request, Page 1.

⁶³⁹ CRO 000134. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Narrative Report, 1971, Table No. 1 – Industrial Leasing, Revenue, & Employment.

⁶⁴⁰ FWM 000914 – FWM 000915. Igloo Lease Contract No. 14-16-0003-81-501 by and between U. S. Fish and Wildlife Service and Dooley Brothers, Inc., dated October 1, 1980 Page 1 and Page 1 of 1A.

⁶⁴¹ DOI 000898. Dooley Brothers, Inc., Response to Section 104(e) information request, Page 1.

⁶⁴² Industrial Tenant Roster – March 2001, Crab Orchard National Wildlife Refuge, Section 1, Table 1-3 of this report.

IOP Decontamination

After the IOP operations ended at CONWR, the IOP was to be decontaminated in accordance with a manual developed by the Ordnance Field Director of Ammunition Plants (OFDAP), called "*Shut-Down and Decontamination Procedures for F.D.A.P Facilities.*"⁶⁴³ This manual was to be used as a guide to develop a facility-specific plan for the decontamination of buildings, grounds and equipment.⁶⁴⁴ According to this document, there were several cleaning compounds used for desensitizing various explosives (for a list of and brief discussion of the compounds, see section 3.1.2.3.).

Because Area 6 was used by the IOP as a storage area, it may not have required decontamination (unlike load lines and other production areas). Post-World War II military records are inadequate to determine if this area was decontaminated and, if so, whether it was adequately decontaminated, and if decontamination instructions were followed.

Surface Disposal Area North of Area 6

This area, located approximately 1,800 feet north of HE-6-12, was described as a possible surface disposal area in the 1943 aerial photographs.⁶⁴⁵ A site reconnaissance was done in this area and several 3 to 4 ft high mounds of soil were observed on the site on May 11, 2000.

10.1.3 Area 6 Previous Sampling Results

USEPA Sampling, 1998

In 1998, the United States Environmental Protection Agency (USEPA) collected two samples (20-1 and 20-2) from Area 6 (former AUS-0020). According to USEPA field notes, sample location 20-1 was at the south entrance to Area 6 and sample location 20-2 was at the northwest loading dock of Area 6. There are no coordinates given for these sample locations; therefore, the sample locations are approximate and are not shown on any figures. Samples were tested for semivolatile organic compounds, PAHs, and metals. The results for all detected constituents are listed in Table 10-1A. The following semi-volatile organic compounds (SVOCs) were detected at the site above either USEPA Soil Screening Levels (SSLs) and/or Canadian Soil Quality Guidelines (CSOQGs): benzo[b]fluoranthene (2.0 milligrams per kilogram (mg/kg)), indeno[1,2,3-cd]pyrene (1.6 mg/kg), dibenz[a,h]anthracene (1.1 mg/kg), and benzo[k]fluoranthene (2.0 mg/kg). Total polynuclear aromatic hydrocarbons (PAHs) also exceeded New Dutchlist Soil Optimum Levels (DSOLs). Barium (170 mg/kg) exceeded USEPA

⁶⁴³ ACO 005047 - ACO 005109. Office of Field Director of Ammunition Plants, Shut-Down and Decontamination Procedures for F.D.A.P. Facilities.

⁶⁴⁴ ACO 004979 - ACO 004980. CONWR Former IOP Uncharacterized Sites Report, Pages 5 and 6.

⁶⁴⁵ Entech, Inc., 1999, Historical Aerial Photographic Analysis - Inventory of Potential Disposal Sites: Additional and Uncharacterized Sites (AUS) Operable Unit, Crab Orchard National Wildlife Refuge, Marion, Illinois, Volume I (Text) Page 3-16 and Volume II (Maps) Page H. The Entech reports analyze historic aerial overflight photographs of industrial areas at the Refuge, from 1943 to 1993. The photos were obtained from the National Archives and Records Administration (NARA) and the U.S. Department of Agriculture Agricultural Stabilization and Conservation Service (ASCS).

SSLs and Refuge background values.⁶⁴⁶ Lead (110 mg/kg) and zinc (140 mg/kg) exceeded DSOLs and Refuge background levels in sample 20-2.

10.1.4 Observations During Site Visit

All of the explosive storage igloos and their associated loading docks were still on site at the time of the site visit in the spring of 1999. Staining was visible on many of the loading docks. There were also floor drains in the igloos that drained outside of the igloos onto the soil. Some ponding occurs in front of many of the igloo truck loading docks, because in many cases the driveway to the igloo slopes downward as it approaches the loading dock.

Both of the former railroad loading docks were still on site, although the railroad lines have been removed. There was a depressed area along the former railroad lines that collects water.

10.1.5 Recommendations Based on Preliminary Assessment

AUS-0A06 was included in the SI because of past industrial storage use that has not been investigated and because USEPA sample results from this site exceeded Preliminary Assessment (PA) screening levels.

10.2 SITE INVESTIGATION INFORMATION

URS conducted a Site Investigation at AUS-0A06 from April 4 to April 5, 2000. The rationale for sample locations, media, and analytes is presented in the Field Sampling Plan (FSP)⁶⁴⁷ for the AUS OU PA/SI. Since the time the FSP was prepared, additional information has become available, and the historic discussion (Section 10.1) has been updated to include that information. The sampling locations discussed below are based on the information that was available at the time the FSP was developed, and may not address all areas of potential releases.

AUS OU SI sample locations are shown on Figures 10-2 and 10-3. Survey coordinates for all sample locations in Area 6 are found in Table 10-2. Table 10-3 summarizes the matrices sampled at this site. Soil was the only medium sampled.

10.2.1 Field Investigation

Sample locations were randomly selected due to the lack of specific information regarding which companies were present in which igloos at the time the FSP was prepared. To select sample locations, the igloo loading docks in Area 6 were numbered from 1 to 86 (including the north and south railroad loading docks) and 26 random numbers (sample locations 0A06-001 through 0A06-026) were chosen using a random number generator (30% sampling rate). All samples were collected from directly beneath the loading areas, in areas where spillage of materials would be most likely.

⁶⁴⁶ See Table 1-11 of this report for Refuge background soil values used for the PA.

⁶⁴⁷ U.S. Fish & Wildlife Service, Department of the Interior, March 2000, Draft Final Field Sampling Plan Site Inspection, Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge Superfund Site, Marion, Illinois (Williamson County), prepared by URS Corporation.

Igloo HE-1-3

Sample 0A06-001 was collected from next to Igloo HE-1-3. It was not known what, if any, activities occurred at this location since this igloo was never built.

Igloo HE-1-6

Sample 0A06-002 was collected from next to the loading dock of Igloo HE-1-6. The SWDC/War Department used this igloo for storage of high explosives, and Olin/Primex/GDO&TS used it for storage of explosives and hazardous waste.

Igloo HE-1-8

Sample 0A06-003 was collected from next to the loading dock of Igloo HE-1-8. SWDC/War Department used this igloo for storage of high explosives. Olin/Primex/GDO&TS used this igloo for explosives storage.

Igloo HE-2-3

Sample 0A06-004 was collected from next to the loading dock of Igloo HE-2-3. SWDC/War Department used this igloo for storage of high explosives. Both Trojan Powder Company and Olin/Primex/GDO&TS used this igloo for explosives storage.

Igloo HE-2-5

Sample 0A06-005 was collected from next to the loading dock of Igloo HE-2-5. SWDC/War Department used this igloo for storage of high explosives. Both Trojan Powder Company and John Kelly used this igloo for explosives storage; and World Fireworks Display used this igloo for fireworks storage. Silverado Fireworks is the current tenant in this igloo.

Igloo HE-2-8

Sample 0A06-006 was collected from next to the loading dock of Igloo HE-2-8. SWDC/War Department used this igloo for storage of high explosives. Both Trojan Powder Company and Austin Powder Company leased this building for storage of explosives. Ensign Bickford is the current tenant in this building.

Transfer Platform HE-2-13

It is likely that this loading/unloading platform was used both during the IOP era and by post-World War II Area 6 tenants (listed in Table 10-1 below). It is likely that this platform was used by those tenants that occupied the center row of Area 6 (Igloos HE-4-1 through HE-4-12), since both are along the rail line. Sample 0A06-007 was collected from next to this loading platform to detect possible contamination related to spillage during transfer.

Igloo HE-3-4

Sample 0A06-008 was collected from next to the loading dock at Igloo HE-3-4. SWDC/War Department used this igloo for storage of high explosives. Olin/Primex/GDO&TS used this igloo for storage of "E.A./J.M." propellant.

Igloo HE-3-6

Sample 0A06-009 was collected from next to the loading dock at Igloo HE-3-6. SWDC/War Department used this igloo for storage of high explosives. Olin/Primex/GDO&TS used this igloo for explosives storage including "MT."

Igloo HE-3-10

Sample 0A06-010 was collected from next to the loading dock of Igloo HE-3-10. SWDC/War Department used this igloo for storage of high explosives. Both Trojan Powder Company and Hanley Industries leased this building for explosives storage.

Igloo HE-3-11

Sample 0A06-011 was collected from next to the loading dock of Igloo HE-3-11. SWDC/War Department used this igloo for storage of high explosives. Both Trojan Powder Company and Austin Powder Company leased this building for storage of explosives. Ensign Bickford is the current tenant in this building.

Igloo HE-4-5

Sample 0A06-012 was collected from next to the loading dock at Igloo HE-4-5. SWDC/War Department used this igloo for storage of high explosives. UMC also used this igloo for storage. Olin/Primex/GDO&TS used this igloo for storage of 20mm and 30mm RDX.

Igloo HE-4-6

Sample 0A06-013 was collected from next to the loading dock at Igloo HE-4-6. SWDC/War Department used this igloo for storage of high explosives. UMC also used this igloo for storage. Olin/Primex/GDO&TS used this igloo for storage of 20mm and 30mm RDX.

Igloo HE-4-12

Sample 0A06-014 was collected from next to the loading dock of Igloo HE-4-12. SWDC/War Department used this igloo for storage of high explosives. UMC used this igloo for storage along with Trojan Powder Company (explosives storage) and the U.S. Treasury Department, BATF.

Igloo HE-5-4

Sample 0A06-015 was collected from next to the loading dock of Igloo HE-5-4. SWDC/War Department used this igloo for storage of high explosives. UMC also used this igloo for storage. Olin/Primex/GDO&TS used this igloo for explosives storage.

Igloo HE-5-8

Sample 0A06-016 was collected from next to the loading dock of Igloo HE-5-8. SWDC/War Department used this igloo for storage of high explosives. UMC also used this igloo for storage. Austin Powder Company leased this building for storage of explosives. Ensign Bickford is the current tenant in this building.

Igloo HE-6-2

Sample 0A06-017 was collected from next to the loading dock of Igloo HE-6-2. SWDC/War Department used this igloo for storage of high explosives, and Petrof Trading Company reportedly used this igloo for storage of smokeless powder. Mine Service Company, Inc. used this building for storage of explosive-related materials, and DYNNO-NOBEL currently occupies this building.

Igloo HE-6-3

Sample 0A06-018 was collected from next to the loading dock of Igloo HE-6-3. SWDC/War Department used this igloo for storage of high explosives, and Petrof Trading Company reportedly used this igloo for storage of smokeless powder. Olin/Primex/GDO&TS used this igloo for explosives storage.

Igloo HE-6-5

Sample 0A06-019 was collected from next to the loading dock of Igloo HE-6-5. SWDC/War Department used this igloo for storage of high explosives, and Petrof Trading Company reportedly used this igloo for storage of smokeless powder. DuPont reportedly used this igloo for storage of explosives such as TOVEX. Olin/Primex/GDO&TS used this igloo for explosives storage.

Igloo HE-6-9

Sample 0A06-020 was collected from next to the loading dock of Igloo HE-6-9. SWDC/War Department used this igloo for storage of high explosives, and Petrof Trading Company reportedly used this igloo for storage of smokeless powder. SIU also leased this building for storage. Later, Austin Powder Company leased this building for storage of explosives. Ensign Bickford is the current tenant in this building.

Igloo HE-7-1

Sample 0A06-021 was collected from next to the loading dock of Igloo HE-7-1. SWDC/War Department used this igloo for storage of high explosives. Olin/Primex/GDO&TS used this igloo for explosives and hazardous waste storage.

Igloo HE-7-4

Sample 0A06-022 was collected from next to Igloo HE-7-4. It was not known what, if any, activities occurred at this location since this igloo was never built.

Igloo HE-7-8

Sample 0A06-023 was collected from next to the loading dock of Igloo HE-7-8. SWDC/War Department used this igloo for storage of high explosives and DuPont reportedly used this igloo for storage of explosives such as TOVEX. Olin/Primex/GDO&TS used this igloo for explosives storage.

Igloo HE-7-9

Sample 0A06-024 was collected from next to the loading dock of Igloo HE-7-9. SWDC/War Department used this igloo for storage of high explosives, and DuPont reportedly used this igloo for storage of explosives such as TOVEX. Both Circle R. Powder and Explosive Company and Olin/Primex/GDO&TS used this igloo for explosives storage.

Igloo HE-7-10

Sample 0A06-025 was collected from next to the loading dock of Igloo HE-7-10. SWDC/War Department used this igloo for storage of high explosives, and DuPont reportedly used this igloo for storage of explosives such as TOVEX. Later, Dooley Brothers, Inc. were reported to have likely used this igloo for storage of explosives such as: ANFO P, blasting caps, high density primers, TOVEX, dynamite and fuses.

Igloo HE-7-11

Sample 0A06-026 was collected from next to the loading dock of Igloo HE-7-11. SWDC/War Department used this igloo for storage of high explosives, and Dooley Brothers, Inc. likely used this igloo for storage of explosives such as: ANFO P, blasting caps, high density primers, TOVEX, dynamite and fuses. As noted above, Dooley Brothers, Inc. buried explosive materials next to Igloos HE-7-11 and HE-7-12 on two occasions.⁶⁴⁸ The explosive materials buried at these two igloos include "Tovex 100, MS-5 Primacord Connectors, Ignitacord, and MS-75 Primadet and MS-100 Primadet."⁶⁴⁹ The exact location of the buried explosives was not identified.

⁶⁴⁸ DOI 000900. Dooley Brothers, Inc., Response to Section 104(e) information request, Page 3.

⁶⁴⁹ DOI 000921. Dooley Bros., Delivery Ticket, DT-B 00695 for explosives destroyed, dated April 27, 1979.

10.2.2 Field Results**10.2.2.1 Site Conditions****10.2.2.1.1 *Geologic Conditions***

No monitoring wells or test pits were installed in Area 6. Therefore the available geologic information was obtained through surface soil samples. The surface soil samples indicate that the top 6 inches of material at the site includes fill material (silty clay). The majority of the samples also contained sand and/or gravel.

10.2.2.1.2 *Hydrogeologic Conditions*

Hydrogeologic information for Area 6 is unavailable. No wells have been installed in this area.

10.2.2.1.3 *Hydrologic Conditions*

As shown in Figure 10-1, there are several ponds in Area 6. Some temporary ponding occurs in front of many of the igloo truck loading docks, because in many cases the driveway leading from the road to the igloo slopes downward as it approaches the loading dock. Additional ponding occurs along the former railroad lines, which were left as depressed areas after the railroad lines were removed.

There are also ditches along the roadways in Area 6.

10.2.2.2 Chemical Results

Table 10-4 lists the chemicals detected in Area 6 along with the frequency and range of detections. Tabulated results of all analyses are included in the Quality Control Summary Report (QCSR).

Sample results are presented on the following figures:

- Figure 10-2 -- organic results for soil, and
- Figure 10-3 -- inorganic results for soil.

10.3 SCREENING RISK ASSESSMENT

Results of the screening are presented in Tables 10-5 and 10-6, as follows:

- Table 10-5-- human health risk screening for soils, and
- Table 10-6-- ecological risk screening for soils.

Each table lists the maximum detected concentration for each constituent analyzed at Area 6. The screening results are presented in the tables in terms of hazard quotients (HQs). The HQ for any chemical detected, for any particular screening criterion is simply the ratio of the maximum detected concentration to the screening concentration. For human health for carcinogens, a screening level "cancer risk" is calculated instead of a HQ.

Chemicals that are shaded in the tables are those that exceeded the screening criteria, and are identified as chemicals of potential concern (COPCs) for human health risk, and chemicals of potential ecological concern (COPECs) for ecological risk. The only COPCs/COPECs not shaded in the table are those inorganic constituents that exceeded the screening criteria but were detected at levels below Refuge background.

In cases where the chemical was analyzed but not detected, the HQ is the ratio between the maximum reporting limit and the screening concentration. Chemicals not detected are identified with a "U" qualifier in the qualifier column. When these HQ values exceed one, they are not shaded. These constituents are not identified as COPCs/COPECs, but rather as uncertainties.

In Figures 10-2 and 10-3, the shading convention used is the same as for the tables discussed above. The particular screening criteria exceeded are indicated by the code in the analytical results labels. Duplicate results are shown only if the duplicate result for an analyte exceeded the screening criteria and the result from the original sample did not; or, if the analyte was detected in the duplicate and not in the original sample. Since in the screening process results which are qualified as estimated (coded with "J") are treated the same as unqualified results, data qualifiers are not included in the results shown in the figures. Refer to the QCSR for data qualifiers.

Tables 10-7 (human health risk) and 10-8 (ecological risk) list all the analytes and corresponding media sampled and indicate whether each is a COPC (or COPEC), not a COPC (or COPEC), or an uncertainty. The codes in the tables indicate the rationale for each classification. All COPCs (Table 10-7) and COPECs (Table 10-8) are shaded in the tables.

10.3.1 Human Health Risk

10.3.1.1 Soil

Human health screening results for soil samples are presented in Table 10-5. For carcinogens, a cancer risk was calculated using the USEPA Region 9 Industrial Soil Preliminary Remediation Goals (PRGs) as screening values. The cancer risk was derived by calculating a ratio of the maximum detected concentrations, or the maximum reporting limits, to their appropriate screening values. These ratios were then multiplied by 1×10^{-6} . In addition, ratios were calculated using the USEPA Region 9 Industrial Soil PRG for Toxins, the USEPA Region 9 Migration to Groundwater Criteria (Dilution Attenuation Factor (DAF)=1), the Illinois Tiered Approach to Corrective Action Objectives (TACO) Industrial/Commercial Soil Ingestion Criteria, the Illinois TACO Construction Worker Soil Ingestion Criteria, and the Illinois TACO Class I Soil Component of Groundwater Criteria.

10.3.2 Ecological Risk

10.3.2.1 Soil

Ecological screening results for soil samples are presented in Table 10-6. Soil screening concentrations for direct exposures were developed using toxicity reference values (TRVs) derived from several sources, including the following:

- USEPA (2000)⁶⁵⁰
- Environment Canada (1995)⁶⁵¹
- Talmage *et al.* (1999)⁶⁵²
- Efroymson *et al.* (1997a, 1997b)⁶⁵³
- CCME (1999)⁶⁵⁴
- MHSPE (1994)⁶⁵⁵
- Other sources

A detailed discussion of the screening concentration selection is presented in Appendix G.

The screening approach for ingestion pathway exposures was based on the potential for a chemical to bioaccumulate. The potential for a chemical to bioaccumulate was based on the organic chemical-specific octanol-to-water partitioning coefficient (K_{ow}), which provides an indication of the lipophilicity of an organic chemical, and its potential for sequestration in biological tissue. The document *Assessment and Control of Bioconcentratable Contaminants in Surface Waters* (USEPA 1991)⁶⁵⁶ used a log K_{ow} of 3.5 as a target threshold value indicative of bioaccumulative chemicals to target organic chemicals of greatest concern. Using this as a guideline, organic chemicals with a log K_{ow} greater than 3.5 were considered potentially bioaccumulative chemicals. Among inorganics, mercury and selenium were considered as potentially bioaccumulative chemicals. Any potentially bioaccumulative chemical that is detected was retained as a COPEC.

10.4 SCIENTIFIC MANAGEMENT DECISION POINT

A Remedial Investigation (RI) is recommended for Site AUS-0A06, based on exceedances of the SI screening criteria.

This report recommends that inorganic constituents that exceeded project screening criteria but were within Refuge background levels not be retained as COPCs/COPECs for further evaluation. These are the constituents coded with "D" on the COPC list, Table 10-7; and on the COPEC list,

⁶⁵⁰ USEPA. 2000. Ecological Soil Screening Level Guidance (Draft). USEPA Office of Emergency and Remedial Response, Washington, DC.

⁶⁵¹ Environment Canada. 1995. Toxicity Testing of NCSRP Priority Substances for Development of Soil Quality Guidelines for Contaminated Sites. Guidelines Division, Evaluation and Interpretation Branch, Environmental Conservation Directorate, Environment Canada. Hull, Quebec.

⁶⁵² Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E. Welsh, F. M. Cretella, P.H. Reno, and F. B. Daniel. 1999. Nitroaromatic Munition Compounds: Environmental Effects and Screening Values. *Rev Environ. Contam. Toxicol* 161:1-156.

⁶⁵³ Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997a. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision*. Oak Ridge National Laboratory, Oak Ridge, Tennessee. ES/ER/TM-85/R3.

Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997b. *Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision*. Oak Ridge National Laboratory, Oak Ridge, Tennessee. ES/ER/TM-126/R2.

⁶⁵⁴ Canadian Council of Ministers of the Environment. 1999. Canadian Environmental Quality Guidelines.

⁶⁵⁵ Ministry of Housing, Spatial Planning, and the Environment (MHSPE). 1994. *Intervention Values and Target Values – Soil Quality Standards*. Directorate General for Environmental Protection, Department of Soil Protection, The Hague, The Netherlands.

⁶⁵⁶ USEPA 1991. *Assessment and Control of Bioconcentratable Contaminants in Surface Waters* (Draft). US Environmental Protection Agency Office of Research and Development, Washington, D.C.

Table 10-8. COPCs in this category include antimony, arsenic, barium, chromium, nickel and selenium in soil. COPECs coded with "D" on Table 10-8 include arsenic, chromium, manganese and selenium in soil. These chemicals may later be included in the RI for other reasons (for example, as standard components in an analytical method; if new information on site usage suggests they should be evaluated; or if they are of concern in other media) but the detections at the locations noted are not considered to be of concern since they are below Refuge background levels. All other COPCs/COPECs listed on these tables should be evaluated in the RI. In addition, all analytes listed as uncertainties on these tables should be considered for further evaluation in the RI Work Plan.

Chemicals that exceeded screening criteria and Refuge background (if applicable) are listed in Table 10-9.

Note that a number of the human health COPCs exceed migration to groundwater screening criteria. Groundwater has not been investigated at this site, and based on these data, should be considered in the RI. Other areas of the site and media and contaminants in addition to those addressed in this study may warrant investigation in the RI. These issues will be addressed in the work plan for the RI. The discussion of past usage included in this section should be carefully reviewed during work plan development, since this information was updated after the field investigation, and all potential release areas at this site may not have been investigated in the SI.

**TABLE 10-1
AREA 6 OPERATORS/LESSEES AND IGLOO USES**

Operator/Lessee	Date of Occupancy	Igloo Number	Use of Igloos
Atlas Powder Company	1976-1997	HE-1-10	Explosives storage
Austin Powder Company	1967 to 2000	HE-1-12, HE-2-7, HE-2-8, HE-2-9, HE-2-10, HE-3-7, HE-3-11, HE-5-5, HE-5-7, HE-5-8, HE-5-9, HE-5-10, HE-5-11, HE-6-8, HE-6-9, HE-6-10	Temporary storage of commercial explosives for resale (e.g. composition B, detonating cord, dry explosive containing PETN, cast boosters, solid explosives in boxes, dynamite, ANFO, mix of AN prills and fuel oil in plastic-lined bags)
Circle R Powder & Explosive Co.	1986-1991	HE-7-9	Explosives storage
Civil Air Patrol (Group 12)	1970-1978 (possibly as early as 1968)	HE-3-2	Storage of surplus equipment
Crab Orchard National Wildlife Refuge	1998	HE-2-1	Storage of metal drums containing propellant (likely M-6)
DeNeal, Sam B.	1971-1978 (possibly as early as 1968)	HE-1-7, HE-1-8	Unknown
Dooley Brothers, Inc.	Various times from 1971 to 2001	HE-4-9, HE-5-2, HE-5-6, HE-7-10, HE-7-11, HE-7-12	Storage of explosives (i.e. ANFO P, blasting caps, high density primers, TOVEX, dynamite, fuses)
El Dorado Chemical Company	Various times from 1983 to 1990	HE-1-10, HE-2-12, HE-4-7, HE-4-8	Explosives/components distribution (likely ammonium nitrate fertilizer, sulphate of ammonia, and urea fertilizer)
E. I. DuPont	1978-1980 (possibly as early as 1971)	HE-5-2, HE-6-4, HE-6-5, HE-6-6, HE-6-7, HE-7-2, HE-7-3, HE-7-7, HE-7-8, HE-7-9, HE-7-10	Storage of explosives such as TOVEX
Ensign Bickford	? - Current	HE-1-12, HE-2-7, HE-2-8, HE-2-9, HE-2-10, HE-3-7, HE-3-11, HE-5-7, HE-5-8, HE-5-9, HE-5-10, HE-5-11, HE-6-8, HE-6-9, HE-6-10, HE-7-6	Likely storage of explosives
Explosives, Inc.	1959-1964	HE-1-11, HE-1-12	Unknown
Federal Bureau of Investigations	?-2001	HE-5-5	Unknown
Great Lakes Terminal and Transport Company	1959 up to possibly 1962	HE-3-1, HE-3-2	Storage of agricultural chemical products: aldrin, bidrin, cioldrin, ciovap, dieldrin, endrin, nemagon, phosdrin, planavin, babon, vapon, allyl alcohol, azordin, compound 4072, halbard, methyl parathion, parathion, telodrin, niran, verdan
Warren O. Heidbreder	1970-1978 (possibly as early as 1968)	HE-1-12	Explosives storage

TABLE 10-1
AREA 6 OPERATORS/LESSEES AND IGLOO USES

Operator/Lessee	Date of Occupancy	Igloo Number	Use of Igloos
Hanley Industries, Inc.	1959-1966, 1981-Present	HE-2-12, (presently in HE-3-10 and HE-4-9)	Black powder and high explosives storage
Illinois State Police	?-2001	HE-4-7	Unknown
Jupiter Blasting	1971-1975	HE-6-11	Explosives storage
Kelley, John	1989-1991	HE-1-5 (1989), HE-2-5	Explosives storage
Kilbourn Specialists	1970-1972	HE-2-5	Unspecified storage
Marion Civil Defense/Williamson County Emergency Management Agency (formerly Emergency Service and Disaster Agency)	1962 - Current	HE-3-1, HE-5-1, HE-5-3, HE-5-12	Storage of beds, medical supplies, and food rations
Mine Service Co. (DYNO NOBEL)	1976 - Current	HE-4-2, HE-6-1, HE-6-2, HE-6-11	Explosives storage (mostly blasting caps and blasting agents)
Monsanto Company	1979-1983	HE-4-8	Storage of ammonium nitrate fertilizers, explosives, sulphate of ammonia and urea
Olin/Primex/GDO&TS	Various dates (see text)	HE-1-2 HE-1-4, HE-1-5, HE-1-6, HE-1-7, HE-1-8, HE-1-9, HE-1-10, HE-1-11, HE-2-2, HE-2-3, HE-2-4, HE-2-6, HE-2-11, HE-2-12, HE-3-3, HE-3-4, HE-3-5, HE-3-6, HE-3-8, HE-3-9, HE-4-3, HE-4-4, HE-4-5, HE-4-6, HE-4-8, HE-4-10, HE-4-11, HE-5-4, HE-6-3, HE-6-4, HE-6-5, HE-6-6, HE-6-7, HE-7-1, HE-7-6, HE-7-7, HE-7-8, HE-7-9	Explosives and explosive component storage. Some igloos stored hazardous waste (see text).
Petrof Trading Company	Various times from 1961 to 1966 and 1970 to 1971	HE-6-1, HE-6-2, HE-6-3, HE-6-4, HE-6-5, HE-6-6, HE-6-7, HE-6-8, HE-6-9, HE-6-10, HE-6-11	Smokeless powder storage
Propellex Corporation (a.k.a. Chromalloy American Corporation)	1956-1979, and 1987 - 2001	HE-3-12, HE-7-2, HE-7-3	Materials storage (likely explosives)
Sangamo	1956 to possibly 1962	HE-6-1	Unknown
SWDC/War Department	1942-1945	All igloos in Area 6	High explosives storage
Silverado Fireworks	2001	HE-2-5	Unknown
Sontec	1985-1986	HE-7-2, HE-7-3	Storage of explosives

**TABLE 10-1
AREA 6 OPERATORS/LESSEES AND IGLOO USES**

Operator/Lessee	Date of Occupancy	Igloo Number	Use of Igloos
Southern Illinois University	1977-1978	HE-6-8, HE-6-9, HE-6-10	Unspecified storage
S & W Ammunition Company	1972-1976	HE-1-10	Gunpowder in zinc-lined wooden crates
Trojan Powder	1962 - 1973	HE-2-1, HE-2-2, HE-2-3, HE-2-4, HE-2-5, HE-2-6, HE-2-7, HE-2-8, HE-2-9, HE-2-10, HE-2-11, HE-3-5, HE-3-7, HE-3-9, HE-3-10, HE-3-11, HE-4-7, HE-4-9, HE-4-10, HE-4-11, HE-4-12	Explosives storage
U.S. Dept of Treas., Bureau of Alcohol, Tobacco, & Firearms	1973 - 1981, and 2001	HE-4-12	Unspecified storage
Universal Match Co.	Began sometime between 1956 and 1961 (likely some igloos up to 1964)	HE-4-3, HE-4-4, HE-4-5, HE-4-6, HE-4-7, HE-4-8, HE-4-9, HE-4-10, HE-4-11, HE-4-12, HE-5-1, HE-5-2, HE-5-3, HE-5-4, HE-5-5, HE-5-6, HE-5-7, HE-5-8, HE-5-9, HE-5-10, HE-5-11, HE-15-12	Unspecified storage
Wildlife Materials, Inc.	1977 - 1978, 1985 - 1987	HE-4-7, HE-6-10	Storage of black powder (powder form), electric squibs with lead wires attached, and M-6 powder (pellet form)
Winn-Starr, Inc. (a.k.a. Winco Company)	1971-Current	HE-1-1, HE-3-2 (presently)	Storage and/or distribution of explosives and explosive components
World Fireworks Display Co., Inc.	1973-1987	HE-2-5, HE-3-2	Mfg./store/distribute fireworks, pyrotechnic articles/explosives, powder/black powder storage

Sheet 3 of 3

Note: References for the information in this table can be found in Section 10.1.2 of this report.

TABLE 10-1A
1998 USEPA SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Sample ID	Constituent	Result (mg/kg)
20-1	Aluminum	13,000
	Barium	97
	Calcium	0.7
	Chromium	1,600
	Cobalt	17
	Copper	7.5
	Iron	21,000
	Magnesium	2,200
	Manganese	620
	Mercury	0.04
	Nickel	13
	Potassium	860
	Vanadium	36
	Zinc	32
20-2	Benzo[b]fluoranthene	0.66J, 2.0J
	Benzo[k]fluoranthene	2.0J
	Dibenz[a,h]anthracene	1.1J
	Fluoranthene	0.6J
	Indeno[1,2,3-c,d]pyrene	1.6J
	Pyrene	0.7J
	Aluminum	8,100
	Barium	170
	Beryllium	0.7
	Calcium	14,000
	Chromium	12
	Cobalt	9
	Copper	11
	Iron	13,000
	Lead	110
	Magnesium	7,500
	Manganese	750
	Mercury	0.05
	Nickel	15
	Potassium	902
	Vanadium	21
	Zinc	140

Sheet 1 of 1

mg/kg = milligrams per kilogram

J = Estimated

Note: When two results are shown for one constituent, the first result is the semivolatile organics analysis data, and the second result is the polyaromatic hydrocarbons analysis data.

**TABLE 10-2
SURVEY COORDINATES FOR SAMPLE LOCATIONS IN AUS-0A06**

Sample Location	Northing	Easting	Ground Surface Elevation	Top of Casing Elevation	Comments
0A06-001	380811.8	792764.3	426.41	NA	
0A06-002	382165.1	792765.2	429.35	NA	
0A06-003	383025.6	792772.3	443.94	NA	
0A06-004	380648.1	793251.9	431.16	NA	
0A06-005	381517.2	793262.4	433.36	NA	
0A06-006	382806.1	793271.4	440.50	NA	
0A06-007	384813.9	793605.3	425.41	NA	
0A06-008	380859.9	793753.4	433.42	NA	
0A06-009	381726.9	793761.8	431.75	NA	
0A06-010	383441.5	793777.8	444.84	NA	
0A06-011	383870.3	793780.4	441.00	NA	
0A06-012	381027.2	794242.0	429.10	NA	
0A06-013	381508.0	794270.7	427.73	NA	
0A06-014	384087.8	794292.4	427.00	NA	
0A06-015	380429.0	794751.6	423.28	NA	
0A06-016	382136.9	794771.4	426.07	NA	
0A06-017	379339.8	795241.7	417.33	NA	
0A06-018	379791.1	795245.2	416.50	NA	
0A06-019	380633.9	795249.2	419.15	NA	
0A06-020	382349.8	795268.5	426.53	NA	
0A06-021	378693.1	795744.6	425.42	NA	
0A06-022	380043.1	795769.6	412.73	NA	
0A06-023	381710.7	795761.6	415.19	NA	
0A06-024	382140.6	795765.2	420.31	NA	
0A06-025	382571.0	795769.1	424.81	NA	
0A06-026	383000.9	795772.5	430.52	NA	

Sheet 1 of 1

NA = Not Applicable

**TABLE 10-3
MATRICES SAMPLED AT EACH SAMPLE LOCATION AT AUS-0A06**

Soil	
AUS-0A06-001	AUS-0A06-014
AUS-0A06-002	AUS-0A06-015
AUS-0A06-003	AUS-0A06-016
AUS-0A06-004	AUS-0A06-017
AUS-0A06-005	AUS-0A06-018
AUS-0A06-006	AUS-0A06-019
AUS-0A06-007	AUS-0A06-020
AUS-0A06-008	AUS-0A06-021
AUS-0A06-009	AUS-0A06-022
AUS-0A06-010	AUS-0A06-023
AUS-0A06-011	AUS-0A06-024
AUS-0A06-012	AUS-0A06-025
AUS-0A06-013	AUS-0A06-026

Sheet 1 of 1

TABLE 10-4
SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Constituent	Number of Detections	Range of Detections
Semivolatile Organic Compounds		
2,4,5-Trichlorophenol	1/26	40 ug/kg
2,4,6-Trichlorophenol	1/26	42 ug/kg
2-Methylnaphthalene	8/26	45 ug/kg to 230 ug/kg
4-Bromophenyl phenyl ether	1/26	42 ug/kg
4-Chloro-3-methylphenol	1/26	53 ug/kg
4-Chlorophenyl phenyl ether	1/26	37 ug/kg
4-Methylphenol	1/26	71 ug/kg
4-Nitrophenol	1/26	59 ug/kg
Acenaphthene	5/26	41 ug/kg to 430 ug/kg
Acenaphthylene	1/26	37 ug/kg
Anthracene	9/26	42 ug/kg to 1,000 ug/kg
Benzo(a)anthracene	17/26	49 ug/kg to 8,700 ug/kg
Benzo(a)pyrene	16/26	64 ug/kg to 8,400 ug/kg
Benzo(b)fluoranthene	19/26	50 ug/kg to 10,000 ug/kg
Benzo(g,h,i)perylene	15/26	42 ug/kg to 4,100 ug/kg
Benzo(k)fluoranthene	17/26	52 ug/kg to 7,300 ug/kg
Bis (2-Chloroisopropyl) ether	1/26	54 ug/kg
Bis (2-Ethylhexyl) phthalate (DEHP)	14/26	50 ug/kg to 220 ug/kg
Butyl benzyl phthalate	1/26	73 ug/kg
Carbazole	9/26	45 ug/kg to 660 ug/kg
Chrysene	21/26	41 ug/kg to 11,000 ug/kg
Di-n-butyl phthalate	4/26	43 ug/kg to 130 ug/kg
Di-n-octyl phthalate	1/26	120 ug/kg
Dibenz(a,h)anthracene	8/26	47 ug/kg to 2,300 ug/kg
Dibenzofuran	9/26	40 ug/kg to 610 ug/kg
Diethyl phthalate	1/26	50 ug/kg
Dimethyl phthalate	1/26	40 ug/kg
Fluoranthene	20/26	44 ug/kg to 12,000 ug/kg
Fluorene	5/26	38 ug/kg to 480 ug/kg
Hexachlorobenzene	1/26	39 ug/kg
Indeno(1,2,3-c,d)pyrene	15/26	52 ug/kg to 4,200 ug/kg
Naphthalene	6/26	49 ug/kg to 160 ug/kg
N-Nitroso-di-n-propylamine	1/26	41 ug/kg
N-nitrosodiphenylamine	2/26	38 ug/kg to 240 ug/kg
Pentachlorophenol	1/26	47 ug/kg
Phenanthrene	16/26	58 ug/kg to 5,000 ug/kg
Phenol	2/26	40 ug/kg to 57 ug/kg
Pyrene	19/26	73 ug/kg to 11,000 ug/kg
Explosives		
Nitrobenzene	1/26	550 ug/kg
Other Inorganics		
Total Organic Carbon	1/26	13,700 mg/kg
Metals		
Aluminum	26/26	466 mg/kg to 17,300 mg/kg
Antimony	4/26	0.28 mg/kg to 0.41 mg/kg
Arsenic	16/26	1.4 mg/kg to 11.5 mg/kg

TABLE 10-4
SOIL SAMPLE ANALYTICAL RESULTS SUMMARY

Constituent	Number of Detections	Range of Detections
Barium	26/26	3.1 mg/kg to 123 mg/kg
Boron	8/26	1.6 mg/kg to 6.5 mg/kg
Cadmium	14/26	0.089 mg/kg to 0.53 mg/kg
Calcium	26/26	1650 mg/kg to 348,000 mg/kg
Chromium	26/26	1.1 mg/kg to 18.1 mg/kg
Cobalt	9/26	4 mg/kg to 6.2 mg/kg
Copper	24/26	2.5 mg/kg to 32.4 mg/kg
Iron	26/26	991 mg/kg to 24,900 mg/kg
Lead	22/26	8.8 mg/kg to 48.8 mg/kg
Magnesium	26/26	751 mg/kg to 93,600 mg/kg
Manganese	26/26	23.3 mg/kg to 918 mg/kg
Mercury	24/26	0.051 mg/kg to 0.48 mg/kg
Nickel	25/26	2.7 mg/kg to 15.6 mg/kg
Potassium	26/26	145 mg/kg to 2,090 mg/kg
Selenium	15/26	0.25 mg/kg to 1.5 mg/kg
Thallium	1/26	0.2 mg/kg
Vanadium	24/26	0.88 mg/kg to 27.5 mg/kg
Zinc	26/26	6.6 mg/kg to 83.3 mg/kg

Sheet 2 of 2

mg/kg = milligrams per kilogram

ug/kg = micrograms per kilogram

Notes: This table was derived from the figures that show the analytical results. As a result, duplicates are shown only if the duplicate result for an analyte exceeded the screening criteria and the result from the original sample did not; or, if the analyte was detected in the duplicate and not in the original sample. There may be some duplicate results not shown in the table that are outside the range shown. In addition, the frequency and range of detections is based on the number of sample locations, not the total number of samples (the total number of samples includes originals plus duplicates).

Checked by: ARE 5/25/01

**TABLE 10-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 6 (AUS-0A06)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
Semivolatile Organic Compounds								
120-82-1	1,2,4-Trichlorobenzene	680	U	UG/KG			8.93E-05	2.27E+00
95-50-1	1,2-Dichlorobenzene	680	U	UG/KG			2.05E-04	7.56E-01
541-73-1	1,3-Dichlorobenzene	680	U	UG/KG			1.31E-02	
106-46-7	1,4-Dichlorobenzene	680	U	UG/KG		8.37E-08	3.54E-04	6.80E+00
95-95-4	2,4,5-Trichlorophenol	40	J	UG/KG			4.54E-07	4.00E-03
88-06-2	2,4,6-Trichlorophenol	42	J	UG/KG		1.87E-10		5.25E+00
120-83-2	2,4-Dichlorophenol	680	U	UG/KG			2.57E-04	1.36E+01
105-67-9	2,4-Dimethylphenol	680	U	UG/KG			3.86E-05	1.70E+00
51-28-5	2,4-Dinitrophenol	3400	U	UG/KG			1.93E-03	3.40E+02
91-58-7	2-Chloronaphthalene	680	U	UG/KG			2.49E-05	
95-57-8	2-Chlorophenol	680	U	UG/KG			2.82E-03	3.40E+00
91-57-6	2-Methylnaphthalene	230	J	UG/KG			4.24E-06	1.15E-03
95-48-7	2-Methylphenol	680	U	UG/KG			1.54E-05	8.50E-01
88-74-4	2-Nitroaniline	3400	U	UG/KG			6.75E-02	
88-75-5	2-Nitrophenol	680	U	UG/KG			9.65E-05	
91-94-1	3,3'-Dichlorobenzidine	680	U	UG/KG		1.24E-07		2.27E+03
99-09-2	3-Nitroaniline	3400	U	UG/KG			6.75E-02	
534-52-1	4,6-Dinitro-2-methylphenol	3400	U	UG/KG				
101-55-3	4-Bromophenyl phenyl ether	42	J	UG/KG				
59-50-7	4-Chloro-3-methylphenol	53	J	UG/KG			1.20E-06	
106-47-8	4-Chloroaniline	1400	U	UG/KG			3.97E-04	4.67E+01
7005-72-3	4-Chlorophenyl phenyl ether	37	J	UG/KG				
106-44-5	4-Methylphenol	71	J	UG/KG			1.61E-05	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

**TABLE 10-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 6 (AUS-0A06)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
100-01-6	4-Nitroaniline	3400	U	UG/KG			6.75E-02	
100-02-7	4-Nitrophenol	59	J	UG/KG			8.37E-06	
83-32-9	Acenaphthene	430	J	UG/KG			1.12E-05	1.43E-02
208-96-8	Acenaphthylene	37	J	UG/KG			6.82E-07	1.85E-04
120-12-7	Anthracene	1000		UG/KG			2.57E-06	1.67E-03
56-55-3	Benzo(a)anthracene	8700		UG/KG		3.01E-06		1.09E+02
50-32-8	Benzo(a)pyrene	8400		UG/KG		2.91E-05		2.10E+01
205-99-2	Benzo(b)fluoranthene	10000		UG/KG		3.46E-06		5.00E+01
191-24-2	Benzo(g,h,i)perylene	4100		UG/KG			7.56E-05	2.05E-02
207-08-9	Benzo(k)fluoranthene	7300		UG/KG		2.53E-07		3.65E+00
111-91-1	bis(2-Chloroethoxy)methane	680	U	UG/KG				
111-44-4	bis(2-Chloroethyl) ether	680	U	UG/KG		1.10E-06		3.40E+04
108-60-1	bis(2-Chloroisopropyl) ether	54	J	UG/KG		6.68E-09	1.27E-05	
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	6600	E	UG/KG		3.75E-08	3.75E-04	
85-68-7	Butyl benzyl phthalate	73	J	UG/KG			4.14E-07	9.13E-05
86-74-8	Carbazole	660		UG/KG		5.35E-09		2.20E+01
218-01-9	Chrysene	11000		UG/KG		3.81E-08		1.38E+00
84-74-2	Di-n-butyl phthalate	130	J	UG/KG			1.48E-06	4.33E-04
117-84-0	Di-n-octyl phthalate	120	J	UG/KG			6.81E-06	1.20E-05
53-70-3	Dibenz(a,h)anthracene	2300		UG/KG		7.97E-06		2.88E+01
132-64-9	Dibenzofuran	610		UG/KG			1.20E-04	
84-66-2	Diethyl phthalate	50	J	UG/KG			7.09E-08	
131-11-3	Dimethyl phthalate	40	J	UG/KG			4.54E-09	
206-44-0	Fluoranthene	12000		UG/KG			3.99E-04	6.00E-02

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

**TABLE 10-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 6 (AUS-0A06)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
86-73-7	Fluorene	480	J	UG/KG			1.45E-05	1.60E-02
118-74-1	Hexachlorobenzene	39	J	UG/KG		2.53E-08	5.53E-05	3.90E-01
87-68-3	Hexachlorobutadiene	680	U	UG/KG		2.15E-08	3.86E-03	6.80E+00
77-47-4	Hexachlorocyclopentadiene	680	U	UG/KG			1.15E-04	3.40E-02
67-72-1	Hexachloroethane	680	U	UG/KG		3.86E-09	7.72E-04	3.40E+01
193-39-5	Indeno(1,2,3-c,d)pyrene	4200		UG/KG		1.46E-06		6.00E+00
78-59-1	Isophorone	680	U	UG/KG		2.62E-10	3.86E-06	2.27E+01
621-64-7	N-Nitroso-di-n-propylamine	41	J	UG/KG		1.16E-07		2.05E+04
86-30-6	N-Nitrosodiphenylamine	240	J	UG/KG		4.77E-10		4.00E+00
91-20-3	Naphthalene	160	J	UG/KG			8.49E-04	4.00E-02
87-86-5	Pentachlorophenol	47	J	UG/KG		4.24E-09	3.30E-06	4.70E+01
85-01-8	Phenanthrene	5000		UG/KG			9.22E-05	2.50E-02
108-95-2	Phenol	57	J	UG/KG			1.08E-07	1.14E-02
129-00-0	Pyrene	11000		UG/KG			2.03E-04	5.50E-02
Explosives								
99-35-4	1,3,5-Trinitrobenzene	510	U	UG/KG			1.93E-05	
99-65-0	1,3-Dinitrobenzene	510	U	UG/KG			5.79E-03	
118-96-7	2,4,6-Trinitrotoluene (TNT)	1000	U	UG/KG		1.22E-08	2.27E-03	
121-14-2	2,4-Dinitrotoluene	510	U	UG/KG			2.89E-04	1.28E+04
606-20-2	2,6-Dinitrotoluene	680	U	UG/KG			7.72E-04	2.27E+04
35572-78-2	2-Amino-4,6-Dinitrotoluene	1000	U	UG/KG				
88-72-2	2-Nitrotoluene (ONT)	1000	U	UG/KG				
99-08-1	3-Nitrotoluene	1000	U	UG/KG			4.92E-04	
19406-51-0	4-Amino-2,6-Dinitrotoluene	1000	U	UG/KG				

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

**TABLE 10-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 6 (AUS-0A06)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
99-99-0	4-Nitrotoluene (PNT)	1000	U	UG/KG			4.92E-04	
2691-41-0	HMX	1000	U	UG/KG			2.27E-05	
98-95-3	Nitrobenzene	550		UG/KG			4.81E-03	
55-63-0	Nitroglycerin	1300	U	UG/KG		7.38E-09		
78-11-5	Pentaerythritol tetranitrate (PETN)	2700	U	UG/KG				
121-82-4	RDX	1000	U	UG/KG		4.46E-08	3.78E-04	
479-45-8	Tetryl	1500	U	UG/KG			1.70E-04	
Metals								
7429-90-5	Aluminum	17300		MG/KG	6.01E-01		1.03E-02	
7440-36-0	Antimony	0.41	J	MG/KG	4.94E-01		5.01E-04	1.37E+00
7440-38-2	Arsenic	11.5		MG/KG	8.52E-01	4.22E-06	2.62E-02	1.15E+01
7440-39-3	Barium	123		MG/KG	6.31E-01		9.88E-04	1.54E+00
7440-41-7	Beryllium	1	U	MG/KG	1.32E+00	4.46E-10	2.71E-04	3.33E-01
7440-42-8	Boron	6.5	J	MG/KG	1.23E+00		8.21E-05	
7440-43-9	Cadmium	0.53	J	MG/KG	2.79E+00	1.77E-10	6.54E-04	1.33E+00
7440-70-2	Calcium	348000		MG/KG	1.39E+02			
7440-47-3	Chromium	18.1		MG/KG	7.18E-01	4.04E-08		9.05E+00
7440-48-4	Cobalt	6.2	J	MG/KG	2.86E-01		5.06E-05	
7440-50-8	Copper	32.4		MG/KG	2.87E+00		4.27E-04	
7439-89-6	Iron	24900		MG/KG	1.29E+00		4.07E-02	
7439-92-1	Lead	48.8		MG/KG	2.09E+00			
7439-95-4	Magnesium	93600		MG/KG	6.03E+01			
7439-96-5	Manganese	918		MG/KG	2.52E-01		2.85E-02	
7439-97-6	Mercury	0.48		MG/KG	8.00E+00			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

**TABLE 10-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 6 (AUS-0A06)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to Background (SOIL)	Cancer Risk Based on USEPA Region 9 Industrial Soil PRG for Carcinogens	Hazard Quotient (HQ) Based on USEPA Region 9 Industrial Soil PRG for Toxins	Ratio of Max Concentration (or Max RL) to Migration to Groundwater Criteria (DAF-1)
7440-02-0	Nickel	15.6		MG/KG	8.25E-01		3.82E-04	2.23E+00
2023695	Potassium	2090		MG/KG	3.34E+00			
7782-49-2	Selenium	1.5		MG/KG	6.41E-01		1.47E-04	5.00E+00
7440-22-4	Silver	2	U	MG/KG	3.45E+00		1.96E-04	1.00E+00
7440-23-5	Sodium	340	U	MG/KG	2.00E+00			
7440-28-0	Thallium	0.2	J	MG/KG	4.88E-01		1.40E-06	
7440-62-2	Vanadium	27.5		MG/KG	5.83E-01		1.92E-03	9.17E-02
7440-66-6	Zinc	83.3		MG/KG	1.62E+00		1.36E-04	1.39E-01
Other Parameters								
TOC	TOC	38700	J	MG/KG	1.23E+00			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

**TABLE 10-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 6 (AUS-0A06)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene	680	U	UG/KG	3.40E-05	3.40E-04	1.36E-01
95-50-1	1,2-Dichlorobenzene	680	U	UG/KG	3.78E-06	3.78E-05	4.00E-02
541-73-1	1,3-Dichlorobenzene	680	U	UG/KG			
106-46-7	1,4-Dichlorobenzene	680	U	UG/KG			3.40E-01
95-95-4	2,4,5-Trichlorophenol	40	J	UG/KG	2.00E-07	2.00E-07	1.48E-04
88-06-2	2,4,6-Trichlorophenol	42	J	UG/KG	8.08E-05	3.82E-06	2.10E-01
120-83-2	2,4-Dichlorophenol	680	U	UG/KG	1.11E-04	1.11E-03	6.80E-01
105-67-9	2,4-Dimethylphenol	680	U	UG/KG	1.66E-05	1.66E-05	7.56E-02
51-28-5	2,4-Dinitrophenol	3400	U	UG/KG	8.29E-04	8.29E-03	1.70E+01
91-58-7	2-Chloronaphthalene	680	U	UG/KG			
95-57-8	2-Chlorophenol	680	U	UG/KG	6.80E-05	6.80E-05	1.70E-01
91-57-6	2-Methylnaphthalene	230	J	UG/KG	3.77E-06	3.77E-06	5.48E-05
95-48-7	2-Methylphenol	680	U	UG/KG	6.80E-06	6.80E-06	4.53E-02
88-74-4	2-Nitroaniline	3400	U	UG/KG			
88-75-5	2-Nitrophenol	680	U	UG/KG			
91-94-1	3,3'-Dichlorobenzidine	680	U	UG/KG	5.23E-02	2.43E-03	9.71E+01
99-09-2	3-Nitroaniline	3400	U	UG/KG			
534-52-1	4,6-Dinitro-2-methylphenol	3400	U	UG/KG			
101-55-3	4-Bromophenyl phenyl ether	42	J	UG/KG			
59-50-7	4-Chloro-3-methylphenol	53	J	UG/KG			
106-47-8	4-Chloroaniline	1400	U	UG/KG	1.71E-04	1.71E-03	2.00E+00
7005-72-3	4-Chlorophenyl phenyl ether	37	J	UG/KG			
106-44-5	4-Methylphenol	71	J	UG/KG			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

**TABLE 10-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 6 (AUS-0A06)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
100-01-6	4-Nitroaniline	3400	U	UG/KG			
100-02-7	4-Nitrophenol	59	J	UG/KG			
83-32-9	Acenaphthene	430	J	UG/KG	3.58E-06	3.58E-06	7.54E-04
208-96-8	Acenaphthylene	37	J	UG/KG	6.07E-07	6.07E-07	8.81E-06
120-12-7	Anthracene	1000		UG/KG	1.64E-06	1.64E-06	8.33E-05
56-55-3	Benzo(a)anthracene	8700		UG/KG	1.09E+00	5.12E-02	4.35E+00
50-32-8	Benzo(a)pyrene	8400		UG/KG	1.05E+01	4.94E-01	1.05E+00
205-99-2	Benzo(b)fluoranthene	10000		UG/KG	1.25E+00	5.88E-02	2.00E+00
191-24-2	Benzo(g,h,i)perylene	4100		UG/KG	6.72E-05	6.72E-05	9.76E-04
207-08-9	Benzo(k)fluoranthene	7300		UG/KG	9.36E-02	4.29E-03	1.49E-01
111-91-1	bis(2-Chloroethoxy)methane	680	U	UG/KG			
111-44-4	bis(2-Chloroethyl) ether	680	U	UG/KG	1.36E-01	9.07E-03	1.70E+03
108-60-1	bis(2-Chloroisopropyl) ether	54	J	UG/KG			
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)	6600	E	UG/KG	1.61E-02	1.61E-03	1.83E-03
85-68-7	Butyl benzyl phthalate	73	J	UG/KG	1.78E-07	1.78E-07	7.85E-05
86-74-8	Carbazole	660		UG/KG	2.28E-03	1.06E-04	1.10E+00
218-01-9	Chrysene	11000		UG/KG	1.41E-02	6.47E-04	6.88E-02
84-74-2	Di-n-butyl phthalate	130	J	UG/KG	6.50E-07	6.50E-07	5.65E-05
117-84-0	Di-n-octyl phthalate	120	J	UG/KG	2.93E-06	2.93E-05	1.20E-05
53-70-3	Dibenz(a,h)anthracene	2300		UG/KG	2.88E+00	1.35E-01	1.15E+00
132-64-9	Dibenzofuran	610		UG/KG			
84-66-2	Diethyl phthalate	50	J	UG/KG	5.00E-08	5.00E-08	1.06E-04
131-11-3	Dimethyl phthalate	40	J	UG/KG			
206-44-0	Fluoranthene	12000		UG/KG	1.46E-04	1.46E-04	2.79E-03

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

**TABLE 10-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 6 (AUS-0A06)**

**ADDITIONAL AND UNCHARACTERIZED SITES ON
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
86-73-7	Fluorene	480	J	UG/KG	5.85E-06	5.85E-06	8.57E-04
118-74-1	Hexachlorobenzene	39	J	UG/KG	9.75E-03	5.00E-04	1.95E-02
87-68-3	Hexachlorobutadiene	680	U	UG/KG			
77-47-4	Hexachlorocyclopentadiene	680	U	UG/KG	4.86E-05	4.86E-05	1.70E-03
67-72-1	Hexachloroethane	680	U	UG/KG	3.40E-04	3.40E-04	1.36E+00
193-39-5	Indeno(1,2,3-c,d)pyrene	4200		UG/KG	5.25E-01	2.47E-02	3.00E-01
78-59-1	Isophorone	680	U	UG/KG	1.66E-06	1.66E-06	8.50E-02
621-64-7	N-Nitroso-di-n-propylamine	41	J	UG/KG	5.13E-02	2.28E-03	8.20E+02
86-30-6	N-Nitrosodiphenylamine	240	J	UG/KG	2.00E-04	9.60E-06	2.40E-01
91-20-3	Naphthalene	160	J	UG/KG	1.95E-06	1.95E-05	1.90E-03
87-86-5	Pentachlorophenol	47	J	UG/KG	1.96E-03	9.04E-05	1.57E+00
85-01-8	Phenanthrene	5000		UG/KG	8.20E-05	8.20E-05	1.19E-03
108-95-2	Phenol	57	J	UG/KG	5.70E-08	4.75E-07	5.70E-04
129-00-0	Pyrene	11000		UG/KG	1.80E-04	1.80E-04	2.62E-03
Explosives							
99-35-4	1,3,5-Trinitrobenzene	510	U	UG/KG			
99-65-0	1,3-Dinitrobenzene	510	U	UG/KG			
118-96-7	2,4,6-Trinitrotoluene (TNT)	1000	U	UG/KG			
121-14-2	2,4-Dinitrotoluene	510	U	UG/KG	6.07E-02	2.83E-03	6.38E+02
606-20-2	2,6-Dinitrotoluene	680	U	UG/KG	8.10E-02	3.78E-03	9.71E+02
35572-78-2	2-Amino-4,6-Dinitrotoluene	1000	U	UG/KG			
88-72-2	2-Nitrotoluene (ONT)	1000	U	UG/KG			
99-08-1	3-Nitrotoluene	1000	U	UG/KG			
19406-51-0	4-Amino-2,6-Dinitrotoluene	1000	U	UG/KG			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

**TABLE 10-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 6 (AUS-0A06)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
99-99-0	4-Nitrotoluene (PNT)	1000	U	UG/KG			
2691-41-0	HMX	1000	U	UG/KG			
98-95-3	Nitrobenzene	550		UG/KG	5.50E-04	5.50E-04	5.50E+00
55-63-0	Nitroglycerin	1300	U	UG/KG			
78-11-5	Pentaerythritol tetranitrate (PETN)	2700	U	UG/KG			
121-82-4	RDX	1000	U	UG/KG			
479-45-8	Tetryl	1500	U	UG/KG			
Metals							
7429-90-5	Aluminum	17300		MG/KG			
7440-36-0	Antimony	0.41	J	MG/KG	5.00E-04	5.00E-03	8.20E-02
7440-38-2	Arsenic	11.5		MG/KG	3.83E+00	1.89E-01	4.11E-01
7440-39-3	Barium	123		MG/KG	8.79E-04	8.79E-03	1.03E-01
7440-41-7	Beryllium	1	U	MG/KG	1.00E+00	3.45E-02	1.52E-01
7440-42-8	Boron	6.5	J	MG/KG	3.61E-05	3.61E-04	
7440-43-9	Cadmium	0.53	J	MG/KG	2.65E-04	2.65E-03	1.43E-01
7440-70-2	Calcium	348000		MG/KG			
7440-47-3	Chromium	18.1		MG/KG	1.81E-03	4.41E-03	6.46E-01
7440-48-4	Cobalt	6.2	J	MG/KG	5.17E-05	5.17E-04	
7440-50-8	Copper	32.4		MG/KG	3.95E-04	3.95E-03	2.95E-03
7439-89-6	Iron	24900		MG/KG			
7439-92-1	Lead	48.8		MG/KG	1.22E-01	1.22E-01	
7439-95-4	Magnesium	93600		MG/KG			
7439-96-5	Manganese	918		MG/KG	9.56E-03	9.56E-02	
7439-97-6	Mercury	0.48		MG/KG	7.87E-04	7.87E-03	3.20E+00

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

**TABLE 10-5
HUMAN HEALTH SCREENING OF SOIL RESULTS FROM AREA 6 (AUS-0A06)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Ratio of Max Concentration (or Max RL) to IEPA Industrial/Commercial Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Construction Worker Soil Ingestion Criteria	Ratio of Max Concentration (or Max RL) to IEPA Class I Soil Component of Groundwater Criteria
7440-02-0	Nickel	15.6		MG/KG	3.80E-04	3.80E-03	2.05E-01
2023695	Potassium	2090		MG/KG			
7782-49-2	Selenium	1.5		MG/KG	1.50E-04	1.50E-03	6.25E-01
7440-22-4	Silver	2	U	MG/KG	2.00E-04	2.00E-03	1.33E+00
7440-23-5	Sodium	340	U	MG/KG			
7440-28-0	Thallium	0.2	J	MG/KG	1.25E-03	1.25E-03	8.33E-02
7440-62-2	Vanadium	27.5		MG/KG	1.96E-03	1.96E-02	2.81E-02
7440-66-6	Zinc	83.3		MG/KG	1.37E-04	1.37E-03	2.31E-02
Other Parameters							
TOC	TOC	38700	J	MG/KG			

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

**TABLE 10-6
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 6 (AUS-0A06)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
Semivolatile Organic Compounds							
120-82-1	1,2,4-Trichlorobenzene		680	U	UG/KG	3.40E-02	
95-50-1	1,2-Dichlorobenzene		680	U	UG/KG	2.30E-01	
541-73-1	1,3-Dichlorobenzene		680	U	UG/KG	1.80E-02	
106-46-7	1,4-Dichlorobenzene		680	U	UG/KG	3.40E-02	
95-95-4	2,4,5-Trichlorophenol		40	J	UG/KG	1.00E-02	YES
88-06-2	2,4,6-Trichlorophenol		42	J	UG/KG	4.20E-03	YES
120-83-2	2,4-Dichlorophenol		680	U	UG/KG	7.77E-03	
105-67-9	2,4-Dimethylphenol		680	U	UG/KG	6.80E+01	
51-28-5	2,4-Dinitrophenol		3400	U	UG/KG	1.70E-01	
91-58-7	2-Chloronaphthalene		680	U	UG/KG	5.58E+01	
95-57-8	2-Chlorophenol		680	U	UG/KG	2.80E+00	
91-57-6	2-Methylnaphthalene		230	J	UG/KG	7.10E-02	YES
95-48-7	2-Methylphenol		680	U	UG/KG	1.68E-02	
88-74-4	2-Nitroaniline		3400	U	UG/KG	4.59E-02	
88-75-5	2-Nitrophenol		680	U	UG/KG	4.25E-01	
91-94-1	3,3'-Dichlorobenzidine		680	U	UG/KG	1.05E+00	
99-09-2	3-Nitroaniline		3400	U	UG/KG	1.08E+00	
534-52-1	4,6-Dinitro-2-methylphenol		3400	U	UG/KG		
101-55-3	4-Bromophenyl phenyl ether		42	J	UG/KG		YES
59-50-7	4-Chloro-3-methylphenol		53	J	UG/KG	6.67E-03	
106-47-8	4-Chloroaniline		1400	U	UG/KG	1.27E+00	
7005-72-3	4-Chlorophenyl phenyl ether		37	J	UG/KG		YES
106-44-5	4-Methylphenol		71	J	UG/KG	4.36E-04	
100-01-6	4-Nitroaniline		3400	U	UG/KG	1.55E-01	
100-02-7	4-Nitrophenol		59	J	UG/KG	8.43E-03	
83-32-9	Acenaphthene		430	J	UG/KG	6.30E-04	YES
208-96-8	Acenaphthylene		37	J	UG/KG	5.42E-05	
120-12-7	Anthracene		1000		UG/KG	6.76E-04	YES
56-55-3	Benzo(a)anthracene		8700		UG/KG	1.67E+00	YES
50-32-8	Benzo(a)pyrene		8400		UG/KG	1.91E-03	YES
205-99-2	Benzo(b)fluoranthene		10000		UG/KG	1.67E-01	YES
191-24-2	Benzo(g,h,i)perylene		4100		UG/KG	3.45E-02	YES
207-08-9	Benzo(k)fluoranthene		7300		UG/KG	1.22E-01	YES
111-91-1	bis(2-Chloroethoxy)methane		680	U	UG/KG	2.24E+00	
111-44-4	bis(2-Chloroethyl) ether		680	U	UG/KG	2.87E-02	
108-60-1	bis(2-Chloroisopropyl) ether		54	J	UG/KG		
117-81-7	bis(2-Ethylhexyl) phthalate (DEHP)		6600	E	UG/KG	7.13E+00	YES
85-68-7	Butyl benzyl phthalate		73	J	UG/KG	3.06E-01	YES
86-74-8	Carbazole		660		UG/KG		YES
218-01-9	Chrysene		11000		UG/KG	2.33E+00	YES

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

**TABLE 10-6
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 6 (AUS-0A06)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
84-74-2	Di-n-butyl phthalate		130	J	UG/KG	6.50E-04	YES
117-84-0	Di-n-octyl phthalate		120	J	UG/KG	1.69E-04	YES
53-70-3	Dibenz(a,h)anthracene		2300		UG/KG	1.25E-01	YES
132-64-9	Dibenzofuran		610		UG/KG		YES
84-66-2	Diethyl phthalate		50	J	UG/KG	5.00E-04	
131-11-3	Dimethyl phthalate		40	J	UG/KG	2.00E-04	
206-44-0	Fluoranthene		12000		UG/KG	9.84E-02	YES
86-73-7	Fluorene		480	J	UG/KG	1.60E-02	YES
118-74-1	Hexachlorobenzene		39	J	UG/KG	3.90E-05	YES
87-68-3	Hexachlorobutadiene		680	U	UG/KG	1.71E+01	
77-47-4	Hexachlorocyclopentadiene		680	U	UG/KG	6.80E-02	
67-72-1	Hexachloroethane		680	U	UG/KG	1.14E+00	
193-39-5	Indeno(1,2,3-c,d)pyrene		4200		UG/KG	3.85E-02	YES
78-59-1	Isophorone		680	U	UG/KG	4.89E-03	
621-64-7	N-Nitroso-di-n-propylamine		41	J	UG/KG	7.54E-02	
86-30-6	N-Nitrosodiphenylamine		240	J	UG/KG	1.20E-02	
91-20-3	Naphthalene		160	J	UG/KG	6.43E-04	
87-86-5	Pentachlorophenol		47	J	UG/KG	7.83E-03	YES
85-01-8	Phenanthrene		5000		UG/KG	1.09E-01	YES
108-95-2	Phenol		57	J	UG/KG	1.43E-03	
129-00-0	Pyrene		11000		UG/KG	1.40E-01	YES
Explosives							
99-35-4	1,3,5-Trinitrobenzene		510	U	UG/KG	1.36E+00	
99-65-0	1,3-Dinitrobenzene		510	U	UG/KG	7.79E-01	
118-96-7	2,4,6-Trinitrotoluene (TNT)		1000	U	UG/KG	3.33E-02	
121-14-2	2,4-Dinitrotoluene		510	U	UG/KG	3.98E-01	
606-20-2	2,6-Dinitrotoluene		680	U	UG/KG	2.07E+01	
35572-78-2	2-Amino-4,6-Dinitrotoluene		1000	U	UG/KG	1.25E-02	
88-72-2	2-Nitrotoluene (ONT)		1000	U	UG/KG		
99-08-1	3-Nitrotoluene		1000	U	UG/KG		
19406-51-0	4-Amino-2,6-Dinitrotoluene		1000	U	UG/KG		
99-99-0	4-Nitrotoluene (PNT)		1000	U	UG/KG		
2691-41-0	HMX		1000	U	UG/KG	4.00E-02	
98-95-3	Nitrobenzene		550		UG/KG	1.38E-02	
55-63-0	Nitroglycerin		1300	U	UG/KG		
78-11-5	Pentaerythritol tetranitrate (PETN)		2700	U	UG/KG		
121-82-4	RDX		1000	U	UG/KG	1.00E-02	
479-45-8	Tetryl		1500	U	UG/KG		
Metals							
7429-90-5	Aluminum	28800	17300		MG/KG		
7440-36-0	Antimony	0.83	0.41	J	MG/KG	8.20E-02	

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

**TABLE 10-6
ECOLOGICAL SCREENING OF SOIL RESULTS FROM AREA 6 (AUS-0A06)**

**ADDITIONAL AND UNCHARACTERIZED SITES OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

CAS Number	Chemical	Background (SOIL)	Max Result or Max Reporting Limit (RL)	Qualifier	Units	Direct Exposure Hazard Quotient (HQ) (SOIL)	Retained as Potential Bioaccumulator
7440-38-2	Arsenic	13.5	11.5		MG/KG	1.28E+00	
7440-39-3	Barium	195	123		MG/KG	2.46E-01	
7440-41-7	Beryllium	0.76	1	U	MG/KG	1.00E-01	
7440-42-8	Boron	5.3	6.5	J	MG/KG	1.30E+01	
7440-43-9	Cadmium	0.19	0.53	J	MG/KG	1.83E-02	
7440-70-2	Calcium	2497	348000		MG/KG		
7440-47-3	Chromium	25.2	18.1		MG/KG	3.62E+00	
7440-48-4	Cobalt	21.7	6.2	J	MG/KG	3.10E-01	
7440-50-8	Copper	11.3	32.4		MG/KG	1.05E+00	
7439-89-6	Iron	19306	24900		MG/KG	1.25E+02	
7439-92-1	Lead	23.4	48.8		MG/KG	1.13E-01	
7439-95-4	Magnesium	1552	93600		MG/KG		
7439-96-5	Manganese	3640	918		MG/KG	9.18E+00	
7439-97-6	Mercury	0.06	0.48		MG/KG	6.86E-02	YES
7440-02-0	Nickel	18.9	15.6		MG/KG	5.20E-01	
2023695	Potassium	625	2090		MG/KG		
7782-49-2	Selenium	2.34	1.5		MG/KG	1.50E+00	YES
7440-22-4	Silver	0.58	2	U	MG/KG	1.00E+00	
7440-23-5	Sodium	170	340	U	MG/KG		
7440-28-0	Thallium	0.41	0.2	J	MG/KG	2.00E-01	
7440-62-2	Vanadium	47.2	27.5		MG/KG	5.98E-01	
7440-66-6	Zinc	51.4	83.3		MG/KG	6.94E-01	
Other Parameters							
TOC	TOC	31393	38700	J	MG/KG		

ND = Not Detected E = Outside of Range UJ = Estimated Nondetect
J = Estimated U = Nondetect

**TABLE 10-7, AUS-0A06
SUMMARY OF HUMAN HEALTH COPC EVALUATION**

**AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
Volatile Organic Compounds								
1,1,1-Trichloroethane	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethane (EDC)	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethene (total)	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA	NA	NA	NA
2-Butanone (MEK)	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone	NA	NA	NA	NA	NA	NA	NA	NA
4-Methyl-2-pentanone (MIBK)	NA	NA	NA	NA	NA	NA	NA	NA
Acetone	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	NA	NA	NA	NA	NA	NA	NA	NA
Bromodichloromethane	NA	NA	NA	NA	NA	NA	NA	NA
Bromoform	NA	NA	NA	NA	NA	NA	NA	NA
Bromomethane	NA	NA	NA	NA	NA	NA	NA	NA
Carbon disulfide	NA	NA	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA	NA	NA	NA	NA
Chloromethane	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	NA	NA	NA	NA	NA	NA	NA	NA
Dibromochloromethane	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA	NA	NA	NA	NA
Methylene chloride	NA	NA	NA	NA	NA	NA	NA	NA
N-Hexane	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethylene (PCE)	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	NA	NA	NA	NA	NA	NA	NA	NA
total Xylenes	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethylene (TCE)	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl chloride	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds								
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	Uncertainty	B
1,2-Dichlorobenzene	NA	NA	NA	NA	NA	NA	No	A
1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA	No	A
1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA	Uncertainty	B
2,4,5-Trichlorophenol	NA	NA	NA	NA	NA	NA	No	F

TABLE 10-7, AUS-0A06
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
2,4,6-Trichlorophenol	NA	NA	NA	NA	NA	NA	Yes	E
2,4-Dichlorophenol	NA	NA	NA	NA	NA	NA	Uncertainty	B
2,4-Dimethylphenol	NA	NA	NA	NA	NA	NA	Uncertainty	B
2,4-Dinitrophenol	NA	NA	NA	NA	NA	NA	Uncertainty	B
2-Chloronaphthalene	NA	NA	NA	NA	NA	NA	No	A
2-Chlorophenol	NA	NA	NA	NA	NA	NA	Uncertainty	B
1-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	No	F
2-Methylphenol	NA	NA	NA	NA	NA	NA	No	A
2-Nitroaniline	NA	NA	NA	NA	NA	NA	No	A
2-Nitrophenol	NA	NA	NA	NA	NA	NA	No	A
3,3'-Dichlorobenzidine	NA	NA	NA	NA	NA	NA	Uncertainty	B
3-Nitroaniline	NA	NA	NA	NA	NA	NA	No	A
4,6-Dinitro-2-methylphenol	NA	NA	NA	NA	NA	NA	No	C
4-Bromophenyl phenyl ether	NA	NA	NA	NA	NA	NA	Uncertainty	G
4-Chloro-3-methylphenol	NA	NA	NA	NA	NA	NA	No	F
4-Chloroaniline	NA	NA	NA	NA	NA	NA	Uncertainty	B
4-Chlorophenyl phenyl ether	NA	NA	NA	NA	NA	NA	Uncertainty	G
4-Methylphenol	NA	NA	NA	NA	NA	NA	No	F
4-Nitroaniline	NA	NA	NA	NA	NA	NA	No	A
4-Nitrophenol	NA	NA	NA	NA	NA	NA	No	F
Acenaphthene	NA	NA	NA	NA	NA	NA	No	F
Accnaphthylene	NA	NA	NA	NA	NA	NA	No	F
Anthracene	NA	NA	NA	NA	NA	NA	No	F
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	Yes	E
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	Yes	E
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	Yes	E
Benzo(g,h,i)perylene	NA	NA	NA	NA	NA	NA	No	F
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	Yes	E
bis(2-Chloroethoxy)methane	NA	NA	NA	NA	NA	NA	No	C
bis(2-Chloroethyl) ether	NA	NA	NA	NA	NA	NA	Uncertainty	B
bis(2-Chloroisopropyl) ether	NA	NA	NA	NA	NA	NA	No	F
bis(2-Ethylhexyl) phthalate	NA	NA	NA	NA	NA	NA	No	F
Butyl benzyl phthalate	NA	NA	NA	NA	NA	NA	No	F
Carbazole	NA	NA	NA	NA	NA	NA	Yes	E
Chrysene	NA	NA	NA	NA	NA	NA	Yes	E
Di-n-butyl phthalate	NA	NA	NA	NA	NA	NA	No	F
Di-n-octyl phthalate	NA	NA	NA	NA	NA	NA	No	F
Dibenz(a,h)anthracene	NA	NA	NA	NA	NA	NA	Yes	E
Dibenzofuran	NA	NA	NA	NA	NA	NA	No	F
Diethyl phthalate	NA	NA	NA	NA	NA	NA	No	F
Dimethyl phthalate	NA	NA	NA	NA	NA	NA	No	F
Fluoranthene	NA	NA	NA	NA	NA	NA	No	F

TABLE 10-7, AUS-0A06
SUMMARY OF HUMAN HEALTH COPC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
Fluorene	NA	NA	NA	NA	NA	NA	No	F
Hexachlorobenzene	NA	NA	NA	NA	NA	NA	No	F
Hexachlorobutadiene	NA	NA	NA	NA	NA	NA	Uncertainty	B
Hexachlorocyclopentadiene	NA	NA	NA	NA	NA	NA	No	A
Hexachloroethane	NA	NA	NA	NA	NA	NA	Uncertainty	B
Indeno(1,2,3-c,d)pyrene	NA	NA	NA	NA	NA	NA	Yes	E
Isophorone	NA	NA	NA	NA	NA	NA	Uncertainty	B
N-Nitroso-di-n-propylamine	NA	NA	NA	NA	NA	NA	Yes	E
N-Nitrosodiphenylamine	NA	NA	NA	NA	NA	NA	Yes	E
Naphthalene	NA	NA	NA	NA	NA	NA	No	F
Pentachlorophenol	NA	NA	NA	NA	NA	NA	Yes	E
Phenanthrene	NA	NA	NA	NA	NA	NA	No	F
Phenol	NA	NA	NA	NA	NA	NA	No	F
Pyrene	NA	NA	NA	NA	NA	NA	No	F
Metals and Inorganics								
Aluminum	NA	NA	NA	NA	NA	NA	No	F
Antimony	NA	NA	NA	NA	NA	NA	Yes	D
Arsenic	NA	NA	NA	NA	NA	NA	Yes	D
Barium	NA	NA	NA	NA	NA	NA	Yes	D
Beryllium	NA	NA	NA	NA	NA	NA	Uncertainty	B
Boron	NA	NA	NA	NA	NA	NA	No	F
Cadmium	NA	NA	NA	NA	NA	NA	Yes	E
Calcium	NA	NA	NA	NA	NA	NA	No	H
Chromium	NA	NA	NA	NA	NA	NA	Yes	D
Cobalt	NA	NA	NA	NA	NA	NA	No	F
Copper	NA	NA	NA	NA	NA	NA	No	F
Cyanide, Total	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	No	F
Lead	NA	NA	NA	NA	NA	NA	No	F
Magnesium	NA	NA	NA	NA	NA	NA	No	H
Manganese	NA	NA	NA	NA	NA	NA	No	F
Mercury	NA	NA	NA	NA	NA	NA	Yes	E
Nickel	NA	NA	NA	NA	NA	NA	Yes	D
Potassium	NA	NA	NA	NA	NA	NA	No	H
Selenium	NA	NA	NA	NA	NA	NA	Yes	D
Silver	NA	NA	NA	NA	NA	NA	Uncertainty	B
Sodium	NA	NA	NA	NA	NA	NA	No	C
Thallium	NA	NA	NA	NA	NA	NA	No	F
Vanadium	NA	NA	NA	NA	NA	NA	No	F
Zinc	NA	NA	NA	NA	NA	NA	No	F
Explosives								
1,3,5-Trinitrobenzene	NA	NA	NA	NA	NA	NA	No	A
1,3-Dinitrobenzene	NA	NA	NA	NA	NA	NA	No	A

**TABLE 10-7, AUS-0A06
SUMMARY OF HUMAN HEALTH COPC EVALUATION**

**AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

Chemical	Surface Water		Groundwater		Sediment		Soil	
	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale	COPC (yes/no)	Rationale
2,4,6-Trinitrotoluene (TNT)	NA	NA	NA	NA	NA	NA	No	A
2,4-Dinitrotoluene	NA	NA	NA	NA	NA	NA	Uncertainty	B
2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	Uncertainty	B
2-Amino-4,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	No	C
2-Nitrotoluene (ONT)	NA	NA	NA	NA	NA	NA	No	C
3-Nitrotoluene	NA	NA	NA	NA	NA	NA	No	A
4-Amino-2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	No	C
4-Nitrotoluene (PNT)	NA	NA	NA	NA	NA	NA	No	A
HMX	NA	NA	NA	NA	NA	NA	No	A
Nitrobenzene	NA	NA	NA	NA	NA	NA	Yes	E
Nitroglycerin	NA	NA	NA	NA	NA	NA	No	A
Pentaerythritol tetranitrate (PETN)	NA	NA	NA	NA	NA	NA	No	C
Perchloric Acid	NA	NA	NA	NA	NA	NA	NA	NA
RDX	NA	NA	NA	NA	NA	NA	No	A
Tetryl	NA	NA	NA	NA	NA	NA	No	A
Other Parameters								
Nitrogen, Nitrate-Nitrite	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus, Total (as P)	NA	NA	NA	NA	NA	NA	NA	NA

- A - Chemical was not detected and the reporting limit does not exceed the screening concentration.
- B - Chemical was not detected, but reporting limit was equal to or exceeded screening concentration.
- C - Chemical was not detected and there is no screening concentration.
- D - Chemical was detected and was equal to or exceeded screening concentration, but did not exceed background.
- E - Chemical was detected and was equal to or exceeded screening concentration and background, if applicable.
- F - Chemical was detected and did not exceed screening concentration.
- G - Chemical was detected, but no screening value was available.
- H - Chemical was detected, but it is an essential nutrient.
- J - Chemical was classified as a COPC based on USEPA 1998 data but was not a COPC based on SI data.
- NA - Not Analyzed or not applicable.

**TABLE 10-8, AUS-0A06
SUMMARY OF ECOLOGICAL COPEC EVALUATION**

**AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
Volatile Organic Compounds						
1,1,1-Trichloroethane	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	NA	NA	NA	NA	NA	NA
1,2-Dichloroethane (EDC)	NA	NA	NA	NA	NA	NA
1,2-Dichloroethene (total)	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA	NA
2-Butanone (MEK)	NA	NA	NA	NA	NA	NA
2-Hexanone	NA	NA	NA	NA	NA	NA
4-Methyl-2-pentanone (MIBK)	NA	NA	NA	NA	NA	NA
Acetone	NA	NA	NA	NA	NA	NA
Benzene	NA	NA	NA	NA	NA	NA
Bromodichloromethane	NA	NA	NA	NA	NA	NA
Bromoform	NA	NA	NA	NA	NA	NA
Bromomethane	NA	NA	NA	NA	NA	NA
Carbon disulfide	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	NA	NA	NA	NA	NA	NA
Chlorobenzene	NA	NA	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA	NA	NA
Chloromethane	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	NA	NA	NA	NA	NA	NA
Dibromochloromethane	NA	NA	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA	NA	NA
Methylene chloride	NA	NA	NA	NA	NA	NA
N-Hexane	NA	NA	NA	NA	NA	NA
Styrene	NA	NA	NA	NA	NA	NA
Tetrachloroethylene (PCE)	NA	NA	NA	NA	NA	NA
Toluene	NA	NA	NA	NA	NA	NA
total Xylenes	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	NA	NA	NA	NA	NA	NA
Trichloroethylene (TCE)	NA	NA	NA	NA	NA	NA
Vinyl chloride	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds						
1,2,4-Trichlorobenzene	NA	NA	NA	NA	No	A
1,2-Dichlorobenzene	NA	NA	NA	NA	No	A
1,3-Dichlorobenzene	NA	NA	NA	NA	No	A
1,4-Dichlorobenzene	NA	NA	NA	NA	No	A
2,4,5-Trichlorophenol	NA	NA	NA	NA	Yes	E

TABLE 10-8, AUS-0A06
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
2,4,6-Trichlorophenol	NA	NA	NA	NA	Yes	E
2,4-Dichlorophenol	NA	NA	NA	NA	No	A
2,4-Dimethylphenol	NA	NA	NA	NA	Uncertainty	B
2,4-Dinitrophenol	NA	NA	NA	NA	No	A
2-Chloronaphthalene	NA	NA	NA	NA	Uncertainty	B
2-Chlorophenol	NA	NA	NA	NA	Uncertainty	B
1-Methylnaphthalene	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	NA	Yes	E
2-Methylphenol	NA	NA	NA	NA	No	A
2-Nitroaniline	NA	NA	NA	NA	No	A
2-Nitrophenol	NA	NA	NA	NA	No	A
3,3'-Dichlorobenzidine	NA	NA	NA	NA	Uncertainty	B
3-Nitroaniline	NA	NA	NA	NA	Uncertainty	B
4,6-Dinitro-2-methylphenol	NA	NA	NA	NA	No	C
4-Bromophenyl phenyl ether	NA	NA	NA	NA	Yes	E
4-Chloro-3-methylphenol	NA	NA	NA	NA	No	F
4-Chloroaniline	NA	NA	NA	NA	Uncertainty	B
4-Chlorophenyl phenyl ether	NA	NA	NA	NA	Yes	E
4-Methylphenol	NA	NA	NA	NA	No	F
4-Nitroaniline	NA	NA	NA	NA	No	A
4-Nitrophenol	NA	NA	NA	NA	No	F
Acenaphthene	NA	NA	NA	NA	Yes	E
Acenaphthylene	NA	NA	NA	NA	No	F
Anthracene	NA	NA	NA	NA	Yes	E
Benzo(a)anthracene	NA	NA	NA	NA	Yes	E
Benzo(a)pyrene	NA	NA	NA	NA	Yes	E
Benzo(b)fluoranthene	NA	NA	NA	NA	Yes	E
Benzo(g,h,i)perylene	NA	NA	NA	NA	Yes	E
Benzo(k)fluoranthene	NA	NA	NA	NA	Yes	E
bis(2-Chloroethoxy)methane	NA	NA	NA	NA	Uncertainty	B
bis(2-Chloroethyl) ether	NA	NA	NA	NA	No	A
bis(2-Chloroisopropyl) ether	NA	NA	NA	NA	Uncertainty	G
bis(2-Ethylhexyl) phthalate	NA	NA	NA	NA	Yes	E
Butyl benzyl phthalate	NA	NA	NA	NA	Yes	E
Carbazole	NA	NA	NA	NA	Yes	E
Chrysene	NA	NA	NA	NA	Yes	E
Di-n-butyl phthalate	NA	NA	NA	NA	Yes	E
Di-n-octyl phthalate	NA	NA	NA	NA	Yes	E
Dibenz(a,h)anthracene	NA	NA	NA	NA	Yes	E
Dibenzofuran	NA	NA	NA	NA	Yes	E
Diethyl phthalate	NA	NA	NA	NA	No	F
Dimethyl phthalate	NA	NA	NA	NA	No	F
Fluoranthene	NA	NA	NA	NA	Yes	E

TABLE 10-8, AUS-0A06
SUMMARY OF ECOLOGICAL COPEC EVALUATION

AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
Fluorene	NA	NA	NA	NA	Yes	E
Hexachlorobenzene	NA	NA	NA	NA	Yes	E
Hexachlorobutadiene	NA	NA	NA	NA	Uncertainty	B
Hexachlorocyclopentadiene	NA	NA	NA	NA	No	A
Hexachloroethane	NA	NA	NA	NA	Uncertainty	B
Indeno(1,2,3-c,d)pyrene	NA	NA	NA	NA	Yes	E
Isophorone	NA	NA	NA	NA	No	A
N-Nitroso-di-n-propylamine	NA	NA	NA	NA	No	F
N-Nitrosodiphenylamine	NA	NA	NA	NA	No	F
Naphthalene	NA	NA	NA	NA	No	F
Pentachlorophenol	NA	NA	NA	NA	Yes	E
Phenanthrene	NA	NA	NA	NA	Yes	E
Phenol	NA	NA	NA	NA	No	F
Pyrene	NA	NA	NA	NA	Yes	E
Metals and Inorganics						
Aluminum	NA	NA	NA	NA	Uncertainty	I
Antimony	NA	NA	NA	NA	No	F
Arsenic	NA	NA	NA	NA	Yes	D
Barium	NA	NA	NA	NA	No	F
Beryllium	NA	NA	NA	NA	No	A
Boron	NA	NA	NA	NA	Yes	E
Cadmium	NA	NA	NA	NA	No	F
Calcium	NA	NA	NA	NA	Uncertainty	G,H
Chromium	NA	NA	NA	NA	Yes	D
Cobalt	NA	NA	NA	NA	No	F
Copper	NA	NA	NA	NA	Yes	E
Cyanide, Total	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	Yes	E
Lead	NA	NA	NA	NA	No	F
Magnesium	NA	NA	NA	NA	Uncertainty	G,H
Manganese	NA	NA	NA	NA	Yes	D
Mercury	NA	NA	NA	NA	Yes	E
Nickel	NA	NA	NA	NA	No	F
Potassium	NA	NA	NA	NA	Uncertainty	G,H
Selenium	NA	NA	NA	NA	Yes	D
Silver	NA	NA	NA	NA	Uncertainty	B
Sodium	NA	NA	NA	NA	No	C
Thallium	NA	NA	NA	NA	No	F
Vanadium	NA	NA	NA	NA	No	F
Zinc	NA	NA	NA	NA	Yes	J
Explosives						
1,3,5-Trinitrobenzene	NA	NA	NA	NA	Uncertainty	B
1,3-Dinitrobenzene	NA	NA	NA	NA	No	A

**TABLE 10-8, AUS-0A06
SUMMARY OF ECOLOGICAL COPEC EVALUATION**

**AUS OU PA/SI
CRAB ORCHARD NATIONAL WILDLIFE REFUGE**

Chemical	Surface Water		Sediment		Soil	
	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale	COPEC (yes/no)	Rationale
2,4,6-Trinitrotoluene (TNT)	NA	NA	NA	NA	No	A
2,4-Dinitrotoluene	NA	NA	NA	NA	No	A
2,6-Dinitrotoluene	NA	NA	NA	NA	Uncertainty	B
2-Amino-4,6-Dinitrotoluene	NA	NA	NA	NA	No	A
2-Nitrotoluene (ONT)	NA	NA	NA	NA	No	C
3-Nitrotoluene	NA	NA	NA	NA	No	C
4-Amino-2,6-Dinitrotoluene	NA	NA	NA	NA	No	C
4-Nitrotoluene (PNT)	NA	NA	NA	NA	No	C
HMX	NA	NA	NA	NA	No	A
Nitrobenzene	NA	NA	NA	NA	No	F
Nitroglycerin	NA	NA	NA	NA	No	C
Pentaerythritol tetranitrate (PETN)	NA	NA	NA	NA	No	C
Perchloric Acid	NA	NA	NA	NA	NA	NA
RDX	NA	NA	NA	NA	No	A
Tetryl	NA	NA	NA	NA	No	C

- A - Chemical was not detected and the reporting limit does not exceed the screening concentration.
- B - Chemical was not detected, but reporting limit was equal to or exceeded screening concentration.
- C - Chemical was not detected and there is no screening concentration.
- D - Chemical was detected and was equal to or exceeded screening concentration, but did not exceed background.
- E - Chemical was detected and was equal to or exceeded screening concentration and background, if applicable.
- F - Chemical was detected and did not exceed screening concentration.
- G - Chemical was detected, but no screening value was available.
- H - Chemical was detected, but it is an essential nutrient.
- I - If pH<5.5, Aluminum is a COPEC, otherwise it is not.
- J - Chemical was classified as a COPEC based on USEPA 1998 data but was not a COPEC based on SI data.
- NA - Not Analyzed or not applicable.

TABLE 10-9
AUS-0A06 - IOP AMMONIUM NITRATE HIGH EXPLOSIVE SMOKELESS POWDER STORAGE AREA
CHEMICALS DETECTED ABOVE SCREENING CRITERIA AND ABOVE REFUGE BACKGROUND
(WHERE APPLICABLE)

ADDITIONAL AND UNCHARACTERIZED SITES OU SI

Chemical	Drum ¹	Soil	Sediment	Ground Water	Surface Water
SVOCs					
2,4,5-Trichlorophenol		E	NA	NA	NA
2,4,6-Trichlorophenol		H,E	NA	NA	NA
2-Methylnaphthalene		E	NA	NA	NA
4-Bromophenyl phenyl ether		E	NA	NA	NA
4-Chlorophenyl phenyl ether		E	NA	NA	NA
Acenaphthene		E	NA	NA	NA
Anthracene		E	NA	NA	NA
Benzo(a)anthracene		H,E	NA	NA	NA
Benzo(a)pyrene		H,E	NA	NA	NA
Benzo(b)fluoranthene		H,E	NA	NA	NA
Benzo(g,h,i)perylene		E	NA	NA	NA
Benzo(k)fluoranthene		H,E	NA	NA	NA
bis(2-Ethylhexyl)phthalate		E	NA	NA	NA
Butyl benzyl phthalate		E	NA	NA	NA
Carbazole		H,E	NA	NA	NA
Chrysene		H,E	NA	NA	NA
Di-n-butyl phthalate		E	NA	NA	NA
Di-n-octyl phthalate		E	NA	NA	NA
Dibenz(a,h)anthracene		H,E	NA	NA	NA
Dibenzofuran		E	NA	NA	NA
Fluoranthene		E	NA	NA	NA
Fluorene		E	NA	NA	NA
Hexachlorobenzene		E	NA	NA	NA
Indeno(1,2,3-c,d)pyrene		H,E	NA	NA	NA
N-Nitroso-di-n-propylamine		H	NA	NA	NA
N-Nitrosodiphenylamine		H	NA	NA	NA
Pentachlorophenol		H,E	NA	NA	NA
Phenanthrene		E	NA	NA	NA
Pyrene		E	NA	NA	NA
Metals					
Boron		E	NA	NA	NA
Cadmium		H	NA	NA	NA
Copper		E	NA	NA	NA
Iron		E	NA	NA	NA
Mercury		H,E	NA	NA	NA
Zinc		E	NA	NA	NA
Explosives					
Nitrobenzene		H	NA	NA	NA

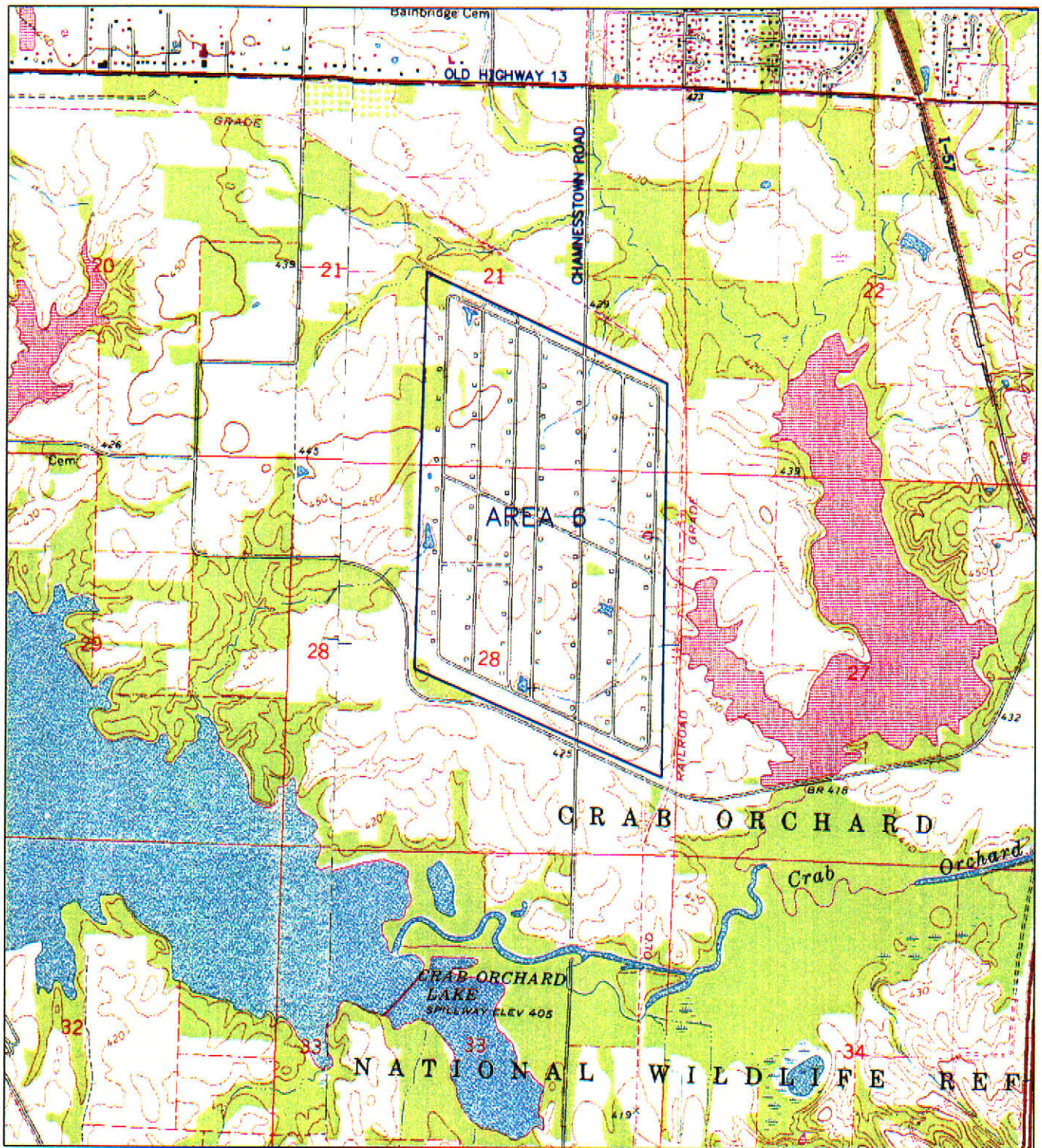
Key:

¹ Drums were not present at this site.

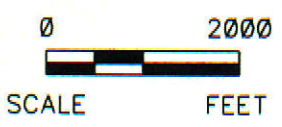
NA = not analyzed

H = human health screening criteria exceeded

E = ecological screening criteria exceeded



SOURCE: USGS DIGITAL RASTER GRAPHIC



PA/SI REPORT-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS		PROJECT NO. 2320000026.00
URS		
DRN. BY: djd 9/7/99 DSGN. BY: mch CHKD. BY: cmw	Area 6 Site Location Map	FIG. NO. 10-1

File: E:\45EOM\9602\N\FIG. 10-1.DWG Last edited: JUN. 28. 01 @ 5:01 p.m. URS Corp.

File: E:\232000026\03\PA-SI-REPORT-AUS OUV TB 10-2.DWG Last edited: AUG. 03, 01 @ 11:02 a.m. URS Corp.

AUS-0A06-005 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-004 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-009 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-008 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-003 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-010 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-011 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-007 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-014 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-009 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-012 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-013 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-016 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-017 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-021 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-018 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

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AUS-0A06-024 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-025 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-028 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-016 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-020 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-021 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

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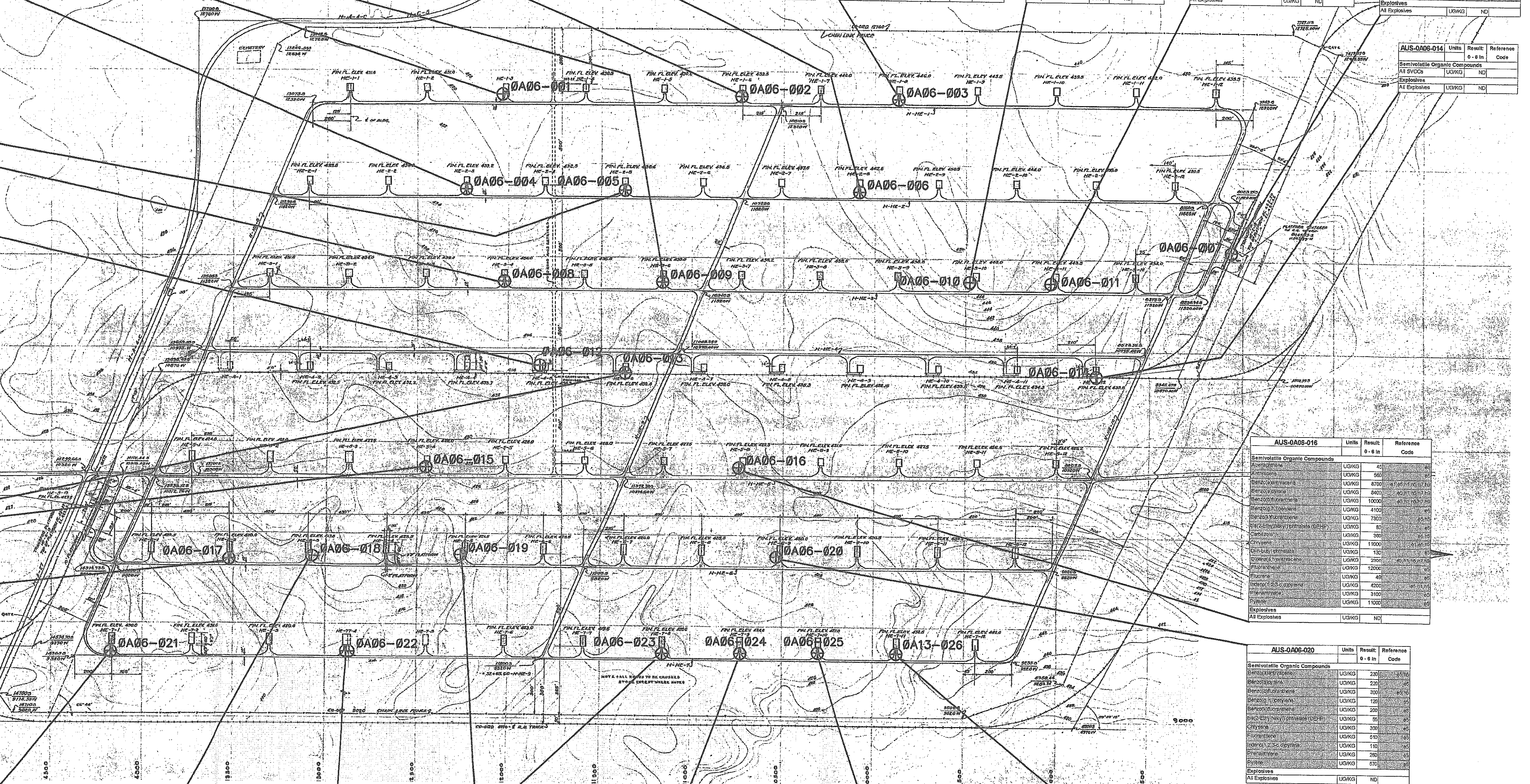
AUS-0A06-024 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-025 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

AUS-0A06-028 Units Result Reference Code table with columns for compound names, units, results, and reference codes.

LEGEND HAND AUGER LOCATION

Screening Reference table listing various environmental standards and their corresponding reference codes.



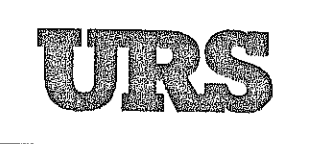
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Revision No., Description, Date, By, App. table for tracking changes to the document.

PA/SI REPORT-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS


AUS-0A06 Sample Locations and Detections of Organic Compounds in Soils

Date, Project Number, Figure Number, Drawn by, Design by, Checked by table with specific project details.



NOTE: 1. DATA QUALIFIERS FOR ANALYTICAL RESULTS ARE NOT INDICATED, REFER TO THE QCSR FOR DATA QUALIFIERS. 2. THE FOLLOWING COMPOUNDS ARE INCLUDED IN THE ANALYTE LIST FOR BOTH SVOCs AND EXPLOSIVES: 2,4-DINITROTOLUENE, 2,6-DINITROTOLUENE, AND NITROBENZENE. THESE COMPOUNDS MAY BE REPORTED AS EITHER SVOCs OR EXPLOSIVES.

BASE MAP SOURCE: ILLINOIS ORDNANCE PLANT, CARBONDALE, ILLINOIS, 1942, LOCATION LAYOUT, AMMONIUM NITRATE-HIGH EXPLOSIVE & SMOKELESS POWDER STORAGE, PLAN NO. 6544-101.10

LEGEND
 HAND AUGER LOCATION

Screening Reference	Reference Code
AUS Background Soil UTL	b1
Little Grassy Background Soil UTL	b2
Little Grassy Background Surface Water UTL	b3
Ecological Direct Exposure Pathway TRV - Soil	e1
Ecological Direct Exposure Pathway TRV - Sediment	e2
Ecological Direct Exposure Pathway TRV - Surface Water	e3
EPA General Use Surface Water Quality Aquatic Life Toxicity	e4
Superfund Chemical Data Matrix Kow values (potential bioaccumulative)	e5
USEPA Region IX Industrial Soil FRG - cancerous	h1
USEPA Region IX Industrial Soil FRG - noncancerous	h2
USEPA Region IX Top Water FRG - cancerous	h3
USEPA Region IX Top Water FRG - noncancerous	h4
USEPA Region IX Migration to Groundwater FRG (DAP-1)	h5
USEPA MCL Drinking Water Standards	b6
EPA TACO Industrial/Commercial Soil Ingestion	b7
EPA TACO Construction Worker Soil Ingestion	b8
EPA TACO Class 1 Soil Component of Groundwater	b9
EPA General Use Surface Water Quality Human Health	b10

Units	Result	Reference Code
Metals		
Aluminum	640	
Antimony	11.16, 27	
Barium	117	b1
Boron	3.3	e1
Cadmium	2100	
Calcium	13.1	e1, b6
Chromium	6.1	b1
Cobalt	11.5	b1
Copper	12.2	e1
Iron	1500	e1
Lead	16.4	b1
Magnesium	2440	b1
Manganese	480	e1
Nickel	0.12	b6
Potassium	400	
Selenium	362	e1
Vanadium	21.6	e1
Zinc	38.1	b1

Units	Result	Reference Code
Metals		
Aluminum	650	
Antimony	11.16, 27	
Barium	117	b1
Boron	3.3	e1
Cadmium	2100	
Calcium	13.1	e1, b6
Chromium	6.1	b1
Cobalt	11.5	b1
Copper	12.2	e1
Iron	1500	e1
Lead	16.4	b1
Magnesium	2440	b1
Manganese	480	e1
Nickel	0.12	b6
Potassium	400	
Selenium	362	e1
Vanadium	21.6	e1
Zinc	38.1	b1

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Manganese	480	e1
Nickel	0.12	b6
Potassium	400	
Selenium	362	e1
Vanadium	21.6	e1
Zinc	38.1	b1

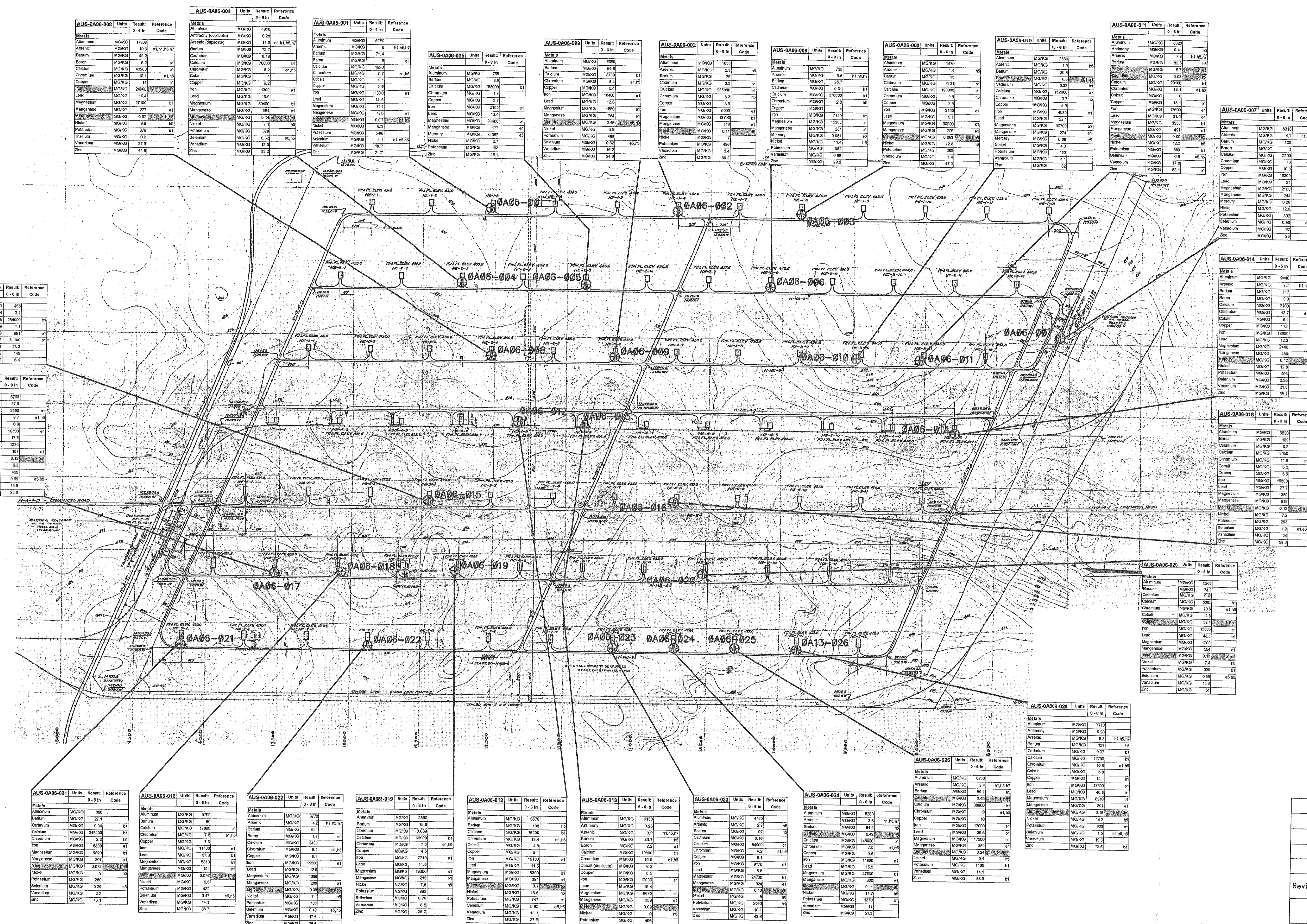
Units	Result	Reference Code
Metals		
Aluminum	650	
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Barium	117	b1
Boron	3.3	e1
Cadmium	2100	
Calcium	13.1	e1, b6
Chromium	6.1	b1
Cobalt	11.5	b1
Copper	12.2	e1
Iron	1500	e1
Lead	16.4	b1
Magnesium	2440	b1
Manganese	480	e1
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Metals		
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Barium	117	b1
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Chromium	6.1	b1
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Manganese	480	e1
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Copper	12.2	e1
Iron	1500	e1
Lead	16.4	b1
Magnesium	2440	b1
Manganese	480	e1
Nickel	0.12	b6
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Chromium	6.1	b1
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Copper	12.2	e1
Iron	1500	e1
Lead	16.4	b1
Magnesium	2440	b1
Manganese	480	e1
Nickel	0.12	b6
Potassium	400	
Selenium	362	e1
Vanadium	21.6	e1
Zinc	38.1	b1

Revision No.	Description	Date	By	App.	
REVISIONS					
PA/SI REPORT-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS					
AUS-0A06 Sample Locations and Detections of Inorganic Compounds in Soils					
Date:	11/14/00	Project Number:	232000026.00	Figure Number:	10-3
Drawn by:	DJD	Design by:	MAM	Checked by:	CMW



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BASE MAP SOURCE: ILLINOIS ORDNANCE PLANT, CARBONDALE, ILLINOIS, 1942,
 LOCATION LAYOUT AMMONIUM NITRATE-HIGH EXPLOSIVE & SMOKELESS POWDER
 STORAGE, PLAN NO. 6544-101.10

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